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Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facililties (air).

For related information see also *Astronautics.*

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VOLUME 27 NUMBER 6 / MARCH 23, 1989

# TABLE OF CONTENTS

## AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics.*

**01 AERONAUTICS (GENERAL)** **N.A.**

**02 AERODYNAMICS** **721**

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*

**03 AIR TRANSPORTATION AND SAFETY** **723**

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

**04 AIRCRAFT COMMUNICATIONS AND NAVIGATION** **724**

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

**05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE** **724**

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

**06 AIRCRAFT INSTRUMENTATION** **725**

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

**07 AIRCRAFT PROPULSION AND POWER** **725**

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

**08 AIRCRAFT STABILITY AND CONTROL** **726**

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

**09 RESEARCH AND SUPPORT FACILITIES (AIR)** **727**

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

## ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*

**12 ASTRONAUTICS (GENERAL)** **727**

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

**13 ASTRODYNAMICS** **N.A.**

Includes powered and free-flight trajectories; and orbital and launching dynamics.

**14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)** **728**

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

**15 LAUNCH VEHICLES AND SPACE VEHICLES** **728**

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

**16 SPACE TRANSPORTATION** **728**

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

**17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING** **N.A.**

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

**18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE** 729

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

**19 SPACECRAFT INSTRUMENTATION** N.A.

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

**20 SPACECRAFT PROPULSION AND POWER** 730

Includes main propulsion systems and components, e.g. rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

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Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

**23 CHEMISTRY AND MATERIALS (GENERAL)** N.A.

**24 COMPOSITE MATERIALS** 730

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

**25 INORGANIC AND PHYSICAL CHEMISTRY** 732

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

**26 METALLIC MATERIALS** 736

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

**27 NONMETALLIC MATERIALS** 739

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

**28 PROPELLANTS AND FUELS** 744

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

**29 MATERIALS PROCESSING** 745

Includes space-based development of products and processes for commercial application.

For biological materials see *55 Space Biology.*

## ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

For related information see also *Physics.*

**31 ENGINEERING (GENERAL)** 746

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

**32 COMMUNICATIONS AND RADAR** 747

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

**33 ELECTRONICS AND ELECTRICAL ENGINEERING** 751

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

**34 FLUID MECHANICS AND HEAT TRANSFER** 753

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

**35 INSTRUMENTATION AND PHOTOGRAPHY** 757

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

**36 LASERS AND MASERS** 760

Includes parametric amplifiers.

For related information see also *76 Solid-State Physics.*

**37 MECHANICAL ENGINEERING** 762

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

**38 QUALITY ASSURANCE AND RELIABILITY** 764

Includes product sampling procedures and techniques; and quality control.

**39 STRUCTURAL MECHANICS** 765

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

## GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

For related information see also *Space Sciences.*

**42 GEOSCIENCES (GENERAL)** 768

**43 EARTH RESOURCES AND REMOTE SENSING** 768

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

**44 ENERGY PRODUCTION AND CONVERSION** 771

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

**45 ENVIRONMENT POLLUTION** 772

Includes atmospheric, noise, thermal, and water pollution.

**46 GEOPHYSICS** 795

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

**47 METEOROLOGY AND CLIMATOLOGY** 798

Includes weather forecasting and modification.

**48 OCEANOGRAPHY** 801

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

## LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

**51 LIFE SCIENCES (GENERAL)** 802

**52 AEROSPACE MEDICINE** 804

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

**53 BEHAVIORAL SCIENCES** 806

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT** 807

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

**55 SPACE BIOLOGY** N.A.

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Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

**59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)** 809

**60 COMPUTER OPERATIONS AND HARDWARE** 809

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

**61 COMPUTER PROGRAMMING AND SOFTWARE** 810

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

**62 COMPUTER SYSTEMS** 815

Includes computer networks and special application computer systems.

**63 CYBERNETICS** 816

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

**64 NUMERICAL ANALYSIS** 822

Includes iteration, difference equations, and numerical approximation.

**65 STATISTICS AND PROBABILITY** 825

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

**66 SYSTEMS ANALYSIS** 827

Includes mathematical modeling; network analysis; and operations research.

**67 THEORETICAL MATHEMATICS** 827

Includes topology and number theory.

## PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

For related information see also *Engineering.*

**70 PHYSICS (GENERAL)** 827

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

**71 ACOUSTICS** 828
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

**72 ATOMIC AND MOLECULAR PHYSICS** 829
Includes atomic structure, electron properties, and molecular spectra.

**73 NUCLEAR AND HIGH-ENERGY PHYSICS** 830
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

**74 OPTICS** 830
Includes light phenomena and optical devices.
For lasers see *36 Lasers and Masers.*

**75 PLASMA PHYSICS** 831
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

**76 SOLID-STATE PHYSICS** 836
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

**77 THERMODYNAMICS AND STATISTICAL PHYSICS** 840
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

## SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

**80 SOCIAL SCIENCES (GENERAL)** 841
Includes educational matters.

**81 ADMINISTRATION AND MANAGEMENT** 848
Includes management planning and research.

**82 DOCUMENTATION AND INFORMATION SCIENCE** 849
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

**83 ECONOMICS AND COST ANALYSIS** N.A.
Includes cost effectiveness studies.

**84 LAW, POLITICAL SCIENCE AND SPACE POLICY** 858
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

**85 URBAN TECHNOLOGY AND TRANSPORTATION** 858
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

## SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

**88 SPACE SCIENCES (GENERAL)** 858

**89 ASTRONOMY** 867
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

**90 ASTROPHYSICS** 867
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

**91 LUNAR AND PLANETARY EXPLORATION** 870
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

**92 SOLAR PHYSICS** 871
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

**93 SPACE RADIATION** 872
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

## GENERAL

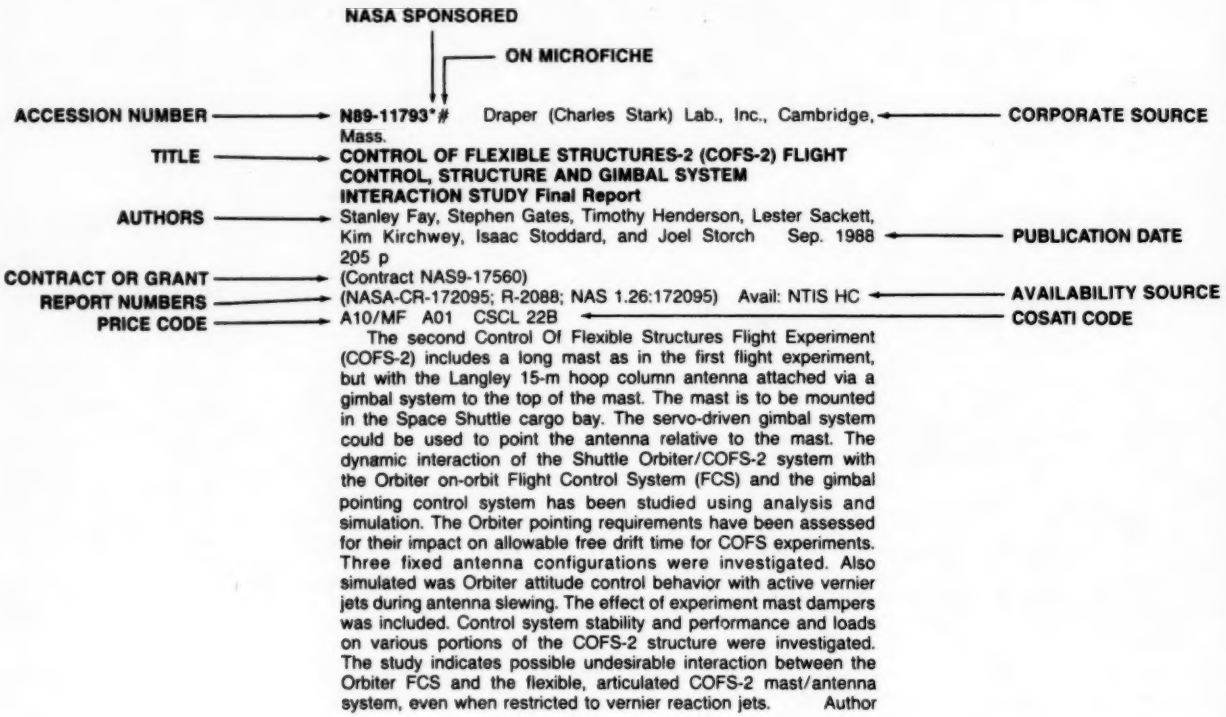
Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

**99 GENERAL** N.A.

**Note: N.A. means that no abstracts were assigned to this category for this issue.**

**SUBJECT INDEX** ..... I-1
**PERSONAL AUTHOR INDEX** ..... I-53
**CORPORATE SOURCE INDEX** ..... I-61
**CONTRACT NUMBER INDEX** ..... I-73
**REPORT/ACCESSION NUMBER INDEX** ..... I-77

# TYPICAL CITATION AND ABSTRACT


NASA SPONSORED
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ACCESSION NUMBER
N89-11793*#
Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
CORPORATE SOURCE
TITLE
CONTROL OF FLEXIBLE STRUCTURES-2 (COFS-2) FLIGHT CONTROL, STRUCTURE AND GIMBAL SYSTEM INTERACTION STUDY Final Report
AUTHORS
Stanley Fay, Stephen Gates, Timothy Henderson, Lester Sackett, Kim Kirchwey, Isaac Stoddard, and Joel Storch
Sep. 1988
PUBLICATION DATE
205 p
CONTRACT OR GRANT
(Contract NAS9-17560)
REPORT NUMBERS
(NASA-CR-172095; R-2088; NAS 1.26:172095)
Avail: NTIS HC
AVAILABILITY SOURCE
PRICE CODE
A10/MF A01 CSCL 22B
COSATI CODE
The second Control Of Flexible Structures Flight Experiment (COFS-2) includes a long mast as in the first flight experiment, but with the Langley 15-m hoop column antenna attached via a gimbal system to the top of the mast. The mast is to be mounted in the Space Shuttle cargo bay. The servo-driven gimbal system could be used to point the antenna relative to the mast. The dynamic interaction of the Shuttle Orbiter/COFS-2 system with the Orbiter on-orbit Flight Control System (FCS) and the gimbal pointing control system has been studied using analysis and simulation. The Orbiter pointing requirements have been assessed for their impact on allowable free drift time for COFS experiments. Three fixed antenna configurations were investigated. Also simulated was Orbiter attitude control behavior with active vernier jets during antenna slewing. The effect of experiment mast dampers was included. Control system stability and performance and loads on various portions of the COFS-2 structure were investigated. The study indicates possible undesirable interaction between the Orbiter FCS and the flexible, articulated COFS-2 mast/antenna system, even when restricted to vernier reaction jets.
Author

VOLUME 27 NUMBER 6 / MARCH 23, 1989

# Scientific and Technical Aerospace Reports

*A Semimonthly Publication of the National Aeronautics and Space Administration*

## 01 AERONAUTICS (GENERAL)

No abstracts in this category.

## 02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

**N89-14213*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**THRUST-REVERSER FLOW INVESTIGATION ON A TWIN-ENGINE TRANSPORT**

Gregory M. Gatlin and P. Frank Quinto Washington, DC Dec. 1988 156 p

(NASA-TP-2856; L-16426; NAS 1.60:2856) Avail: NTIS HC A08/MF A01 CSCL 01A

An investigation was conducted in the NASA Langley 14 x 22 foot Subsonic Tunnel to study the effects of engine thrust reversing on an aft-mounted twin-engine transport and to develop effective testing techniques. Testing was done over a fixed and a moving-belt ground plane and over a pressure instrumented ground board. Free-stream dynamic pressure was set at values up to 12.2 psf, which corresponded to a maximum Reynolds number based on the mean aerodynamic chord of 765,000. The thrust reversers examined included cascade, target and four-door configurations. The investigation focused on the range of free-stream velocities and engine thrust-reverser flow rates that would be typical for landing ground-roll conditions. Flow visualization techniques were investigated, and the use of water or smoke injected into the reverser flow proved effective to determine the forward progression of the reversed flow and reingestion limits. When testing over a moving-belt ground plane, as opposed to a fixed ground plane, forward penetration of the reversed flow was reduced. The use of a pressure-instrumented ground board enabled reversed flow ground velocities to be obtained, and it provided a means by which to identify the reversed flow impingement point on the ground. Author

**N89-14214#** Helsinki Univ. Technology, Otaniemi (Finland). Lab. of Aerodynamics.

**FLUX VECTOR SPLITTING OF THE ONE-DIMENSIONAL EULER EQUATIONS**

Timo Siikonen and Tuomo Saarinen 1988 22 p

(PB88-210109; ISBN-951-754-457-X; B-11) Avail: NTIS HC A03/MF A01 CSCL 01A

So-called flux vector splitting methods have become popular in transonic flow problems. Flux vector splitting allows the use of fully one-sided upwind differences. In the present study a flux-vector splitting technique introduced by Bram van Leer is applied to quasi-1-D transonic flow in a converging-diverging and in a diverging nozzle. Two implicit time integration methods are developed. A second-order accurate boundary layer treatment based on the extrapolation of the characteristic variables is used. The results obtained are as accurate as the results of the implicit MacCormack scheme and are independent of the time step. GRA

**N89-14215*#** Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

**TRANSONIC AEROELASTIC ANALYSIS OF LAUNCH VEHICLE CONFIGURATIONS Ph.D. Thesis**

Joao Luiz FilgueirasdeAzevedo Washington, DC Oct. 1988 167 p

(Grant NGL-05-020-243)

(NASA-CR-4186; NAS 1.26:4186) Avail: NTIS HC A08/MF A01 CSCL 01A

A numerical study of the aeroelastic stability of typical launch vehicle configurations in transonic flight is performed. Recent computational fluid dynamics techniques are used to simulate the transonic aerodynamic flow fields, as opposed to relying on experimental data for the unsteady aerodynamic pressures. The flow solver is coupled to an appropriate structural representation of the vehicle. The aerodynamic formulation is based on the thin layer approximation to the Reynolds-Averaged Navier-Stokes equations, where the account for turbulent mixing is done by the two-layer Baldwin and Lomax algebraic eddy viscosity model. The structural-dynamic equations are developed considering free-free flexural vibration of an elongated beam with variable properties and are cast in modal form. Aeroelastic analyses are performed by integrating simultaneously in the two sets of equations. By tracing the growth or decay of a perturbed oscillation, the aeroelastic stability of a given constant configuration can be ascertained. The method is described in detail, and results that indicate its application are presented. Applications include some validation cases for the algorithm developed, as well as the study of configurations known to have presented flutter programs in the past. Author

**N89-14216*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**TWO-DIMENSIONAL AERODYNAMIC CHARACTERISTICS OF THE OLS/TAAT AIRFOIL**

Michael E. Watts, Jeffrey L. Cross, and Kevin W. Noonan (Army Aviation Research and Development Command, Hampton, VA.) Apr. 1988 92 p

(NASA-TM-89435; A-87132; NAS 1.15:89435) Avail: NTIS HC A05/MF A01 CSCL 01A

Two flight tests have been conducted that obtained extension pressure data on a modified AH-1G rotor system. These two tests, the Operational Loads Survey (OLS) and the Tip Aerodynamics and Acoustics Test (TAAT) used the same rotor set. In the analysis of these data bases, accurate 2-D airfoil data is invaluable, for not only does it allow comparison studies between 2- and 3-D flow, but also provides accurate tables of the airfoil characteristics for use in comprehensive rotorcraft analysis codes. To provide this 2-D data base, a model of the OLS/TAAT airfoil was tested over a Reynolds number range from 3 x 10 to the 6th to 7 x 10 to the 7th and between Mach numbers of 0.34 to 0.88 in the NASA Langley Research Center's 6- by 28-Inch Transonic Tunnel. The 2-D airfoil data is presented as chordwise pressure coefficient plots, as well as lift, drag, and pitching moment coefficient plots and tables. Author

**N89-14217*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**INVESTIGATION OF A MOVING-MODEL TECHNIQUE FOR MEASURING GROUND EFFECT**

Guy T. Kemmerly and John W. Paulson, Jr. Washington, DC Jan. 1989 35 p

(NASA-TM-4080; L-16481; NAS 1.15:4080) Avail: NTIS HC A03/MF A01 CSCL 01A

A ground-based testing technique is under development for the measurement of dynamic or time-dependent ground effects which may be present during aircraft approach and landing. The technique utilizes a model moving horizontally over an upwardly-inclined ground plane to simulate rate of descent. Results were obtained in the Langley Research Center (LaRC) Vortex Research Facility (VRF) for a generic 60 delta wing and for an F-18 configuration, both with and without thrust reversing, at forward speeds up to 100 ft/sec. These same models and support hardware were also tested in the LaRC 14 by 22 Foot Subsonic Tunnel at identical conditions (but without rate of descent) with and without a moving-belt ground plane to obtain data for comparison.

Author

**N89-14218** Minnesota Univ., Minneapolis.
**TWO-EQUATION LOW-REYNOLDS-NUMBER TURBULENCE MODELING OF TRANSITIONAL BOUNDARY LAYER FLOWS CHARACTERISTIC OF GAS TURBINE BLADES Ph.D. Thesis**
Rodney C. Schmidt 1988 283 p
Avail: Univ. Microfilms Order No. DA8811095

The use of low Reynolds number (LRN) forms the k-epsilon turbulence model in predicting transitional boundary layer flow characteristics of gas turbine blades is developed. The research presented consists of: (1) an evaluation of two existing models, (2) the development of a modification to current LRN models, and (3) the extensive testing of the proposed model against experimental data. The prediction characteristics and capabilities of the Jones-Launder and Lam-Bremhorst LRN k-epsilon turbulence models are evaluated with respect to the prediction of transition of flat plates. The mechanism by which the models simulate transition is considered and the need for additional constraints discussed. The transition predictions of the new models are compared with a wide range of different experiments. These include experiments in transitional flows with free stream turbulence. In general, the calculational procedure is shown to yield good agreement with most of the experiments. Some deficiencies are however exhibited, and these are discussed in the spirit of providing guidance for future improvement. Dissert. Abstr.

**N89-14219#** Air Force Inst. of Tech., Wright-Patterson AFB, OH.
**NUMERICAL GRID GENERATION AND POTENTIAL AIRFOIL ANALYSIS AND DESIGN M.S. Thesis**
Mato F. Siladic 1988 138 p
(AD-A197972; AFIT/CI/NR-88-72) Avail: NTIS HC A07/MF A01 CSCL 20D

The primary objective of this thesis is to explore the feasibility of using parabolic partial differential equation techniques for numerical grid generation for two-dimensional aerodynamic configurations. The contents include a discussion of grid generation concepts and schemes in the literature, iterative methods for numerical grid generation and two differential grid generation schemes: (1) an elliptic, and (2) a parabolic scheme. A detailed mathematical and numerical representation of both schemes is given. The main purpose in the treatment of the elliptic scheme is to introduce the necessary transformations to provide equations that will establish the particular parabolic scheme development. Surface singularity methods are found to be a good means for solution of potential flow problems. They can handle both single and multicomponent airfoils in analysis and design processes. The stream function approach appears to be very stable and a simple panel method applicable for practical initial analysis and design airfoil problems. The method provides reduction in the number of panels in comparison with other surface singularity methods and the best results were obtained with 40 to 60 panels per airfoil section. The modified approach for computing the actual position of the trailing edge provides designed airfoils with smooth shapes and stable design process. GRA

**N89-14220*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**NUMERICAL ANALYSIS OF FLOW THROUGH OSCILLATING CASCADE SECTIONS**
Dennis L. Huff Jan. 1989 25 p Prepared for presentation at the 27th Aerospace Sciences Meeting, Reno, NV, 9-12 Jan. 1989; sponsored in part by AIAA
(NASA-TM-101417; E-4509; NAS 1.15:101417; AIAA-89-0437)
Avail: NTIS HC A03/MF A01 CSCL 01A

The design of turbomachinery blades requires the prevention of flutter for all operating conditions. However, flow field predictions used for aeroelastic analysis are not well understood for all flow regimes. The present research focuses on numerical solutions of the Euler and Navier-Stokes equations using an ADI procedure to model two-dimensional, transonic flow through oscillating cascades. The model prescribes harmonic pitching motions for the blade sections for both zero and nonzero interblade phase angles. The code introduces the use of a deforming grid technique for convenient specification of the periodic boundary conditions. Approximate nonreflecting boundary conditions were coded for the inlet and exit boundary conditions. Sample unsteady solutions were performed for an oscillating cascade and compared to experimental data. Also, test cases were run for a flat plate cascade to compare with the unsteady, small-perturbation, subsonic analyis. The predictions for oscillating cascades with nonzero interblade phase angle cases, which were near a resonant condition, differ from the experiment and theory. The zero degree interblade phase angle cases, which were near a resonant condition, differ from the experiment and theory. Studies on reflecting versus nonreflecting inlet and exit boundary conditions show that the treatment of the boundary can have a significant effect on the first harmonic, unsteady pressure distributions for certain flow conditions.

Author

**N89-14221*#** Pratt and Whitney Aircraft, East Hartford, Conn. Engineering Div.
**TURBOFAN FORCED MIXER LOBE FLOW MODELING. 1: EXPERIMENTAL AND ANALYTICAL ASSESSMENT Final Report**
T. Barber, R. W. Paterson, and S. A. Skebe Washington NASA Oct. 1988 155 p
(Contract NAS3-23039)
(NASA-CR-4147-Pt-1; E-4083; NAS 1.26:4147-Pt-1) Avail: NTIS HC A08/MF A01 CSCL 01A

A joint analytical and experimental investigation of three-dimensional flowfield development within the lobe region of turbofan forced mixer nozzles is described. The objective was to develop a method for predicting the lobe exit flowfield. In the analytical approach, a linearized inviscid aerodynamical theory was used for representing the axial and secondary flows within the three-dimensional convoluted mixer lobes and three-dimensional boundary layer analysis was applied thereafter to account for viscous effects. The experimental phase of the program employed three planar mixer lobe models having different waveform shapes and lobe heights for which detailed measurements were made of the three-dimensional velocity field and total pressure field at the lobe exit plane. Velocity data was obtained using Laser Doppler Velocimetry (LDV) and total pressure probing and hot wire anemometry were employed to define exit plane total pressure and boundary layer development. Comparison of data and analysis was performed to assess analytical model prediction accuracy. As a result of this study a planar mixed geometry analysis was developed. A principal conclusion is that the global mixer lobe flowfield is inviscid and can be predicted from an inviscid analysis and Kutta condition. Author

**N89-14222*#** Pratt and Whitney Aircraft, East Hartford, Conn. Engineering Div.
**TURBOFAN FORCED MIXER LOBE FLOW MODELING. 2: THREE-DIMENSIONAL INVISCID MIXER ANALYSIS (FLOMIX) Final Report**
T. Barber Washington NASA Oct. 1988 75 p
(Contract NAS3-23039)
(NASA-CR-4147-Pt-2; E-4084; NAS 1.26:4147-Pt-2) Avail: NTIS HC A04/MF A01 CSCL 01A

A three-dimensional potential analysis (FLOMIX) was formulated and applied to the inviscid flow over a turbofan foced mixer. The

method uses a small disturbance formulation to analytically uncouple the circumferential flow from the radial and axial flow problem, thereby reducing the analysis to the solution of a series of axisymmetric problems. These equations are discretized using a flux volume formulation along a Cartesian grid. The method extends earlier applications of the Cartesian method to complex cambered geometries. The effects of power addition are also included within the potential formulation. Good agreement is obtained with an alternate small disturbance analysis for a high penetration symmetric mixer in a planar duct. In addition, calculations showing pressure distributions and induced secondary vorticity fields are presented for practical trubofan mixer configurations, and where possible, comparison was made with available experimental data. A detailed description of the required data input and coordinate definition is presented along with a sample data set for a practical forced mixer configuration. A brief description of the program structure and subroutines is also provided. Author

**N89-14223** Technische Hogeschool, Delft (Netherlands). Faculteit der Luchtvaart- en Ruimtevaarttechniek.
**A WALK ALONG INTERFACES [EEN WANDELING LANGS RAAKVLAKKEN]**
R. J. Zwann 1988 41 p In DUTCH
(B8817008; ISSN-9-06-275445-7; ETN-89-93456) Copyright Avail: Delft University Press, Stevinweg 1, 2628 CN Delft, Netherlands

Aeroelasticity and its relation to other disciplines is reviewed. Examples of aeroelastic problems are presented. Research items that can play a role in the evaluation, development, and certification of aircraft types are discussed. Transonic adjacent flow, transonic buffet and buzz, and free vortex planes are described. Problems in aircraft vibration are introduced. The investigation of flutter in wind tunnels and during flight is discussed. Aeroelastic tailoring, active control technology, and aeroelastic designs are introduced. ESA

**N89-14224*** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**HIGH LIFT, LOW PITCHING MOMENT AIRFOILS Patent**
Kevin W. Noonan, inventor (to NASA) 11 Oct. 1988 19 p Filed 5 Sep. 1986 Supersedes N87-14282 (25 - 06, p 715)
(NASA-Case-LAR-13215-1; US-Patent-4,776,531; US-Patent-Appl-SN-904132; US-Patent-Class-244-35-R; US-Patent-Class-416-223-R) Avail: US Patent and Trademark Office CSCL 01A

Two families of airfoil sections which can be used for helicopter/rotorcraft rotor blades or aircraft propellers of a particular shape are prepared. An airfoil of either family is one which could be produced by the combination of a camber line and a thickness distribution or a thickness distribution which is scaled from these. An airfoil of either family has a unique and improved aerodynamic performance. The airfoils of either family are intended for use as inboard sections of a helicopter rotor blade or an aircraft propeller.
Official Gazette of the U.S. Patent and Trademark Office

**N89-14897*#** College of William and Mary, Williamsburg, VA. Dept. of Mathematics.
**OPTIMIZATION OF SLENDER WINGS FOR CENTER-OF-PRESSURE SHIFT DUE TO CHANGE IN MACH NUMBER Abstract Only**
Carl M. Andersen *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 36-37 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 01A

**N89-14909*#** Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
**APPROACHES TO NON-LINEAR AERODYNAMIC ANALYSIS AND DESIGN Abstract Only**
Louis B. Gratzer *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 63-64 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 01A

# 03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

**N89-14225#** Army Aviation Engineering Flight Activity, Edwards AFB, CA.
**EVALUATION OF THE IMPROVED OV-1D ANTI-ICING SYSTEM Final Report, 28 Jan. - 21 Feb. 1988**
Joseph Miess, Michael Blacker, and Joseph Piotrowski Apr. 1988 68 p
(AD-A198438; USAAEFA-87-25) Avail: NTIS HC A04/MF A01 CSCL 01C

The U.S. Army Aviation Engineering Flight Activity evaluated the improved OV-1D anti-icing system from 28 January to 21 February 1988 at Duluth, Minnesota. Ten flights (6.5 hours cloud immersion) in artificial conditions and four flights (5.8 hours cloud immersion) in natural conditions were conducted. One enhancing characteristics, nine deficiencies, and three shortcomings were identified. The windshield anti-ice system, when working, enhances safe mission accomplishment. The nine deficiencies were: the inability of the pneumatic deicing system to remove wing and empennage leading edge ice accumulations; the excessive number of AC generator drive shaft failures; the ice accretion characteristics of the engine inlet cowl at temperatures colder than -15 C; the ice accretion and shedding characteristics of the propeller spinner afterbody; the numerous dropouts of one or both windshield anti-ice systems and lack of failure warning to the pilot; the numerous dropouts of the AC generators during flight, the increased pilot workload required to reset them and the distraction caused by illumination of the Master Caution light: the numerous converter dropouts during normal operations, the increased pilot workload required to reset them, and the resulting pilot distractions caused by illumination of the Master Caution light; and the numerous inverter dropouts and the ensuing delay and actions required to reestablish flight essential and normal inverter loads. GRA

**N89-14226#** Aeronautical Systems Div., Wright-Patterson AFB, OH. Crew Station Design Facility.
**COMPARISON OF THE GENERAL DYNAMICS GROUND CLOBBER ALGORITHM WITH THE GCAS AND LAWS ALGORITHMS Final Report, Mar. 1986 - Apr. 1988**
M. A. DiPadua, R. Geiselhart, J. Gavern, and P. Lovering (Midwest Systems Research, Inc., Dayton, OH.) Apr. 1988 170 p
(AD-A198479; ASD-TR-88-5022) Avail: NTIS HC A08/MF A01 CSCL 01D

Three ground avoidance algorithms were evaluated over a variety of mission profiles to determine their effectiveness in avoiding Controlled Flight into Terrain (CFIT) mishaps. Eight Air Force pilots flew nine data collection missions each while subjectively evaluating the system's nuisance warnings. During each mission one of the three algorithms was on-line while the other two were being flown off-line. This provided a mechanism to directly compare each algorithms' performance over identical flight conditions. There were 107 crashes in the experiment resulting in 107 crash plots used for the comparison. The crash plots indicated no significant difference between algorithm performance with regard to crash frequency. The algorithms did differ slightly when performance was evaluated over specific flight regimes, to include diving into flat terrain, level flight into rising terrain, and diving into rising terrain. Subjective evaluation of nuisance warnings indicate significant philosophical differences between the algorithms. GRA

**N89-14227#** Boeing Advanced Systems Co., Seattle, WA.
**FIRE EXTINGUISHING AGENT EVALUATION IN THE AIRCRAFT ENGINE NACELLE FIRE TEST SIMULATOR (AENFTS) Final Report, Jan. 1985 - Mar. 1987**
Alan M. Johnson Jun. 1988 169 p
(Contract F33615-84-C-2431)
(AD-A198523; D180-30962-1; AFWAL-TR-88-2022) Avail: NTIS HC A08/MF A01 CSCL 01B

Fire tests and extinguishant concentration tests were conducted using a simulated portion of the F-16 aircraft engine compartment in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS) at Wright-Patterson Air Force Base. Engine compartment ventilation airflow pressure and temperature were varied to simulate a variation in altitude and ram air pressure. Combat damage simulation included inflow with ambient temperature, simulating outer compartment wall penetration and inflow at elevated temperature simulating fan case perforation or engine bleed air line damage. The length of time between ignition and agent release was found critical, particularly when ventilation air pressure greater than sea level ambient was simulated. The existing Halon 1301 specifications were found to be adequate but a revision is proposed to encourage actual agent release tests with high realism for all planned flight conditions, discourage the use of Halon 1202 and include survivability/vulnerability considerations. GRA

# 04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

**N89-14228*#** Systems Technology, Inc., Hawthorne, Calif.
**AUTONOMOUS RPRV NAVIGATION, GUIDANCE AND CONTROL**
Donald E. Johnston, Thomas T. Myers, and John W. Zellner Mar. 1983 170 p
(Contract NAS4-2896)
(NASA-CR-179425; NAS 1.26:179425; TR-1180-1) Avail: NTIS HC A08/MF A01 CSCL 17G

Dryden Flight Research Center has the responsibility for flight testing of advanced remotely piloted research vehicles (RPRV) to explore highly maneuverable aircraft technology, and to test advanced structural concepts, and related aeronautical technologies which can yield important research results with significant cost benefits. The primary purpose is to provide the preliminary design of an upgraded automatic approach and landing control system and flight director display to improve landing performance and reduce pilot workload. A secondary purpose is to determine the feasibility of an onboard autonomous navigation, orbit, and landing capability for safe vehicle recovery in the event of loss of telemetry uplink communication with the vehicles. The current RPRV approach and landing method, the proposed automatic and manual approach and autoland system, and an autonomous navigation, orbit, and landing system concept which is based on existing operational technology are described.
Author

**N89-14229#** Technische Hogeschool, Delft (Netherlands). Faculty of Geodesy.
**ASPECTS OF INERTIAL INVESTIGATION USING A STRAPDOWN SYSTEM Thesis [ASPEKTEN VAN TRAAGHEIDSNAVIGATIE MET EEN STRAPDOWN SYSTEEM]**
A. J. Klijnjan May 1988 91 p In DUTCH; ENGLISH summary
(ETN-89-93335) Avail: NTIS HC A05/MF A01

Inertial navigation using a strapdown system and its possible applications for geodetic surveys were investigated. In comparison with other inertial systems the strapdown type has many advantages such as minimal mechanical hardware, small size, less power consumption, easy maintenance, lower price, and above all the availability of the raw data. The theoretical and practical aspects characteristic for inertial positioning with strapdown systems are treated. An error model is introduced and proved to be very suitable for computer simulation; it improves the understanding of the perturbation due to systems-specific errors and of their correlation with the travelled route. The influence of sensors was taken into account in the error model. Based on this error model, a general plan for specific strapdown software is given. ESA

**N89-14230#** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Afdeling Verrichtingspsychologie.
**WORKLOAD FOR AIR COMBAT AND AIR TRAFFIC CONTROLLERS**
L. C. Boer, H. J. Leebeek, and A. M. Mimpen Oct. 1987 18 p In DUTCH; ENGLISH summary
(Contract A86/KLu/080)
(IZF-1987-32; ETN-89-93450) Avail: NTIS HC A03/MF A01

The workload level for air combat and air traffic controllers was investigated in a number of control installations. Workload problems are only observed for some of the subaltern officers in air combat control and seem to be due to insufficient information handling capability rather than to the amount of work. Hiring additional personnel is not a way to solve the problem. An exception is the track production (TP) assistant whose workload may be too high despite adequate information handling capabilities. For air combat as well as air traffic control, the ergonomics of the work environment may be improved on a number of points (e.g., more leg room, higher radar screen position, more even illumination level, automatic volume control for the TP officer, noise reducing measures). ESA

# 05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

**N89-14231** Texas A&M Univ., College Station.
**A UNIFIED APPROACH TO VEHICLE DESIGN, CONTROL, AND FLIGHT PATH OPTIMIZATION Ph.D. Thesis**
Rush Daleth Robinett, III 1987 205 p
Avail: Univ. Microfilms Order No. DA8808822

A set of vehicle design and control optimization methods is presented that minimizes the difference between the desired and actual dynamical flight paths. The approach taken seeks the optimum, physically admissible mass properties and/or the thrust history of the vehicle to minimize a quadratic measure of departure from the desired path. The minimization process developed belongs to a family of problems which are commonly referred to as constrained parameter optimization. A recursive quadratic programming algorithm is used to implement the analytical formulation as a numerical algorithm. The derivations are presented of the equations of motion for fixed and variable mass bodies which include the unification of the control volume and particle dynamics analyses of the variable mass body problem. Analytical and numerical optimization procedures are discussed in detail. Basic concepts are defined along with measures of stability and robustness of motion matching in terms of the uniform boundedness of the deviation from the desired flight path. The theoretical results are illustrated with a set of test cases. Dissert. Abstr.

**N89-14232*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**PASSIVE VENTING TECHNIQUE FOR SHALLOW CAVITIES Patent Application**
Robert L. Stallings, Jr., inventor (to NASA) and Floyd J. Wilcox, Jr., inventor (to NASA) 30 Sep. 1988 9 p

(NASA-Case-LAR-14031-1; NAS 1.71:LAR-14031-1; US-Patent-Appl-SN-252081) Avail: NTIS HC A02/MF A01 CSCL 01C

A device is introduced for reducing drag and store separation difficulties caused by shallow cavities on aircraft in supersonic flight consisting of a group of hollow pipes the same length as the cavity. The pipes are attached to the cavity floor so as to allow air to flow through the pipes. This device allows air to flow through the pipes opposite to the direction of flow outside the pipes. This results in reduced drag and improved store separation characteristics. NASA

**N89-14233*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**PASSIVE VENTING TECHNIQUE FOR SHALLOW CAVITIES Patent Application**
Robert L. Stallings, Jr. and Floyd J. Wilcox, Jr. 28 Sep. 1988 11 p
(NASA-Case-LAR-13875-1; NAS 1.71:LAR-13875-1; US-Patent-Appl-SN-250468) Avail: NTIS HC A03/MF A01 CSCL 01C

A device is disclosed for reducing drag and store separation difficulties caused by shallow cavities on aircraft in supersonic flight consisting of a slab of porous material cut to fit precisely inside the cavity. This slab is mounted inside the cavity such that a plemun chamber is formed between the slab and the floor of the cavity. This device allows air to flow through the chamber opposite to the direction of flow outside the chamber. This results in reduced drag and improved store separation characteristics. NASA

**N89-14234#** Logistics Management Inst., Bethesda, MD.
**THE NATURE OF THE AIRCRAFT COMPONENT FAILURE PROCESS: A WORKING NOTE**
F. M. Slay and Craig C. Sherbrooke Feb. 1988 28 p
(Contract MDA903-85-C-0139)
(AD-A197979; LMI-IR701R1) Avail: NTIS HC A03/MF A01 CSCL 01C

The physics of component failures is normally assumed to follow a Poisson process. However, many studies have shown that the component demands in the U.S. Air Force supply system have a variance-to-mean ratio (VMR) much higher than 1.0, the VMR of a Poisson process. This apparent contradiction is resolved by modeling component failures as a Poisson process whose demand rate is not fixed, but rather is itself a stochastic process, wandering over time as a result of various causes such as weather, flying intensity, reliability growth, and, presumably, other unknown factors. Component and program data for the F-16 and A-10 aircraft show that demand over short time periods is Poisson. This is even more apparent when demands per flying hours are used instead of demands per day. However, when demands are aggregated over longer periods of time or more flying hours, the VMR increases. A gamma-Poisson model for future demands as a function of past observations fits the measured data. We call this process planetary Poisson to distinguish it from the general class of nonstationary Poisson models. GRA

**N89-14922*#** Oklahoma Univ., Norman. Dept. of Aerospace and Mechanical Engineering.
**THE POSTSTALL NONLINEAR DYNAMICS AND CONTROL OF AN F-18: A PRELIMINARY INVESTIGATION Abstract Only**
William N. Patten *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 90-92 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 01C

# 06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

**N89-14235*#** Toledo Univ., Ohio. Dept. of Engineering Science.
**A NUMERICAL SIMULATION OF THE FULL TWO-DIMENSIONAL ELECTROTHERMAL DE-ICER PAD Ph.D. Thesis Final Report**
Konstanty C. Masiulaniec Nov. 1988 206 p
(Grant NAG3-72)
(NASA-CR-4194; E-4381; NAS 1.26:4194) Avail: NTIS HC A10/MF A01 CSCL 01D

The ability to predict the time-temperature history of electrothermal de-icer pads is important in the subsequent design of improved and more efficient versions. These de-icer pads are installed near the surface of aircraft components, for the specific purpose of removing accreted ice. The proposed numerical model can incorporate the full 2-D geometry through a section of a region (i.e., section of an airfoil), that current 1-D numerical codes are unable to do. Thus, the effects of irregular layers, curvature, etc., can now be accounted for in the thermal transients. Each layer in the actual geometry is mapped via a body-fitted coordinate transformation into uniform, rectangular computational grids. The relevant heat transfer equations are transformed and discretized. To model the phase change that might occur in any accreted ice, in an enthalpy formulation the phase change equations are likewise transformed and discretized. The code developed was tested against numerous classical numerical solutions, as well as against experimental de-icing data on a UH1H rotor blade obtained from the NASA Lewis Research Center. The excellent comparisons obtained show that this code can be a useful tool in predicting the performance of current de-icer models, as well as in the designing of future models. Author

# 07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

**N89-14236#** Weapons Systems Research Lab., Adelaide (Australia).
**ENGINES FOR MINI-RPV XM-1A**
E. H. Barnard-Brown Jan. 1988 110 p
(AD-A198336; WSRL-0566-TM; DODA-AR-005-348) Avail: NTIS HC A06/MF A01 CSCL 21G

There were very few light-weight reciprocating engines in the five to ten horsepower range existing in Australia or overseas when a program of research and exploratory development of the techniques required to operate unmanned airborne vehicles from a remote base station started in 1975. Those that did were generally single cylinder engines which are difficult to balance over the speed range necessary for mini remotely piloted vehicle (RPV) operation. A twin cylinder Kolbo D238 engine and a larger Herbrandson Dyad 160 engine were flown. When fitted with a locally developed capacitor discharge ignition system, both these engines performed reliably in flight trials of the mini-RPV XM-1A. However, the Kolbo engine had insufficient power for aircraft with a take-off mass of more than about 35 kg. This memorandum records the experience and test results gained at Weapons Systems Research Laboratory (WSRL) on small engines from its mini-RPV program conducted during 1975 to 1981. GRA

**N89-14237*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**ADVANCED CORE TECHNOLOGY: KEY TO SUBSONIC PROPULSION BENEFITS**
Arthur J. Glassman, Christopher A. Snyder, and Gerald Knip, Jr. 1989 13 p Prepared for presentation at the 34th International Gas Turbine and Aeroengine Congress and Exposition, Toronto (Ontario), 4-8 Jun. 1989; sponsored in part by ASME
(NASA-TM-101420; E-4519; NAS 1.15:101420) Avail: NTIS HC A03/MF A01 CSCL 21E

A study was conducted to identify the potential performance benefits and key technology drivers associated with advanced cores for subsonic high bypass turbofan engines. Investigated first were the individual sensitivities of varying compressor efficiency, pressure ratio and bleed (turbine cooling); combustor pressure recovery; and turbine efficiency and inlet temperature on thermal efficiency and core specific power output. Then, engine cycle and mission performance benefits were determined for systems incorporating all potentially achievable technology advancements. The individual thermodynamic sensitivities are shown over a range of turbine temperatures (at cruise) from 2900 to 3500 R and for both constant (current technology) and optimum (maximum thermal efficiency) overall pressure ratios. It is seen that no single parameter alone will provide a large increase in core thermal efficiency, which is the thermodynamic parameter of most concern for transport propulsion. However, when all potentially achievable advancements are considered, there occurs a synergism that produces significant cycle and mission performance benefits. The nature of these benefits are presented along with the technology challenges.
Author

**N89-14238*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**SIMULATION OF 3-D VISCOUS FLOW WITHIN A MULTI-STAGE TURBINE**
John J. Adamczyk, Mark L. Celestina, Tim A. Beach, and Mark Barnett (United Technologies Research Center, East Hartford, Conn.) 1989 14 p Proposed for presentation at the 34th International Gas Turbine and Aeroengine Congress and Exposition, Toronto, Ontario, 4-8 Jun. 1989; sponsored by ASME
(NASA-TM-101376; E-4430; NAS 1.15:101376) Avail: NTIS HC A03/MF A01 CSCL 21E

This work outlines a procedure for simulating the flow field within multistage turbomachinery which includes the effects of unsteadiness, compressibility, and viscosity. The associated modeling equations are the average passage equation system which governs the time-averaged flow field within a typical passage of a blade row embedded within a multistage configuration. The results from a simulation of a low aspect ratio stage and a one-half turbine will be presented and compared with experimental measurements. It will be shown that the secondary flow field generated by the rotor causes the aerodynamic performance of the downstream vane to be significantly different from that of an isolated blade row.
Author

**N89-14239*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**PLOTTING COMPONENT MAPS IN THE NAVY/NASA ENGINE PROGRAM (NNEP): A METHOD AND ITS USAGE**
Robert M. Plencner Jan. 1989 20 p
(NASA-TM-101433; E-4539; NAS 1.15:101433) Avail: NTIS HC A03/MF A01 CSCL 21E

The Navy/NASA Engine Program (NNEP) and the new extended version which handles chemical equilibrium (NNEPEQ) are very general cycle analysis codes that have been used extensively to calculate design and off-design performance of a wide range of turbine engine cycles and configurations. Component maps are used to obtain the off-design engine performance and a matched engine cycle. This paper describes a method of plotting the scaled NNEP compressor and turbine maps as the user runs the NNEP code as well as plotting the operating line defined by all the cases that were computed in that particular NNEP run. Afterwards, an example demonstrates the use of this capability to help analyze an engine cycle model and then make improvements to that cycle.
Author

# 08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

**N89-14240** Maryland Univ., College Park.
**CALCULATION OF THE STEADILY PERIODIC AND GUST RESPONSES OF A HINGELESS ROTOR HELICOPTER USING TWO-DIMENSIONAL TIME DOMAIN UNSTEADY AERODYNAMICS Ph.D. Thesis**
Andrew Seth Elliott 1987 194 p
Avail: Univ. Microfilms Order No. DA8808542

The deterministic and random gust response of a helicopter in forward flight is examined analytically, using a state space formulation in the time domain. The gust response is considered to be a perturbation about the steadily periodic solution. The hingeless rotor blades are modelled structurally as rotating elastic beams undergoing out-of-plane bending. The blades are discretized using the finite element method and the equation of motion are transformed into a modal space using the first few normal models. The rotor hub and fuselage are considered as a rigid body with a single degree of freedom along the shaft axis. The aerodynamic forcing is developed from a two-dimensional unsteady time domain model based on an exponential series approximation for the response to an indicial change in the downwash. Compressibility effects are included. This model is converted to an equivalent state space representation at radial stations along each blade and these states are appended to the state vector. For computation of the steadily periodic rotor responses, the aerodynamic model is extended to include separation effects and dynamic stall. Results are presented for a representative helicopter flying at various combinations of advance ratio, turbulence intensity, and scale length typical of low altitude and nap-of-the-earth flight environments. These include deterministic and statistical blade loads, deflections, and hub motions. Inclusion of an appropriate unsteady model for the aerodynamic forcing is shown to be essential to accurate response prediction at high advanced ratios.
Dissert. Abstr.

**N89-14744#** Aeronautical Systems Div., Wright-Patterson AFB, OH.
**RECONFIGURABLE FLIGHT CONTROL: AN OPPORTUNITY FOR INTEGRATED DIAGNOSTICS**
E. Rachovitsky, J. W. Davison, and R. E. Guth *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 138-161 Prepared in cooperation with Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 01C

# 09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

**N89-14241*** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**THE 13-INCH MAGNETIC SUSPENSION AND BALANCE SYSTEM WIND TUNNEL**
William G. Johnson, Jr. and David A. Dress Jan. 1989 48 p (NASA-TM-4090; L-16515; NAS 1.15:4090) Avail: NTIS HC A03/MF A01 CSCL 14B

NASA Langley has a small, subsonic wind tunnel in use with the 13-inch Magnetic Suspension and Balance System (MSBS). The tunnel is capable of speeds up to Mach 0.5. This report presents tunnel design and construction details. It includes flow uniformity, angularity, and velocity fluctuation data. It also compares experimental Mach number distribution data with computed results for the General Electric Streamtube Curvature Program. Author

**N89-14242#** Illinois Inst. of Tech., Chicago. Fluid Dynamics Research Center.
**EQUIPMENT TO UPGRADE THE FACILITIES OF THE IIT (ILLINOIS INSTITUTE OF TECHNOLOGY) FLUID DYNAMICS RESEARCH CENTER Final Technical Report**
John L. Way, David Williams, Thomas Corke, Hassan Nagib, and Mukund Acharya Jun. 1988 3 p
(Grant AF-AFOSR-0038-87)
(AD-A198084; AFOSR-88-0742TR) Avail: NTIS HC A02/MF A01 CSCL 14B

"We are currently approaching the completion of the National Diagnostic Facility at IIT. The facility is based on a computer-controlled wind tunnel with a test section 4 ft. high, 5 ft. wide and 36 ft. long exhibiting very high quality flow conditions under both constant and oscillating free-stream velocity conditions. The funding of this facility was initiated under a 1983 DOD University Research Instrumentation Program (AFOSR-Grant-83-0339). A key aspect of the wind tunnel design is the manner in which heat energy produced by fan inefficiencies, is removed from the recirculating tunnel air. This involves the first use of turning vanes which also act as heat transfer elements. The system is sized to allow continuous operation of the wind tunnel at speeds of 250 fps, which is 2.5 times those of common university wind tunnels, and two hours of operation at the maximum tunnel velocity of 550 fps. This new and unique facility will be dedicated to basic research at near-flight Reynolds numbers, thereby, aiding in the design of the next generation of aircraft. The equipment acquired under this Grant has made many of these objectives become realities. GRA

**N89-14243#** Rockwell International Corp., Columbus, Ohio. Aircraft Operations.
**FABRICATION AND TESTING OF LIGHTWEIGHT HYDRAULIC SYSTEM SIMULATOR HARDWARE. PHASE 2: ADDENDUM Report, 15 Nov. 1985 - 15 Jul. 1988**
William N. Bickel and Robert K. Haning Jul. 1988 107 p
(Contract N62269-80-C-0261)
(AD-A198524; NA-88-0011; NADC-79024-60-1) Avail: NTIS HC A06/MF A01 CSCL 20D

Follow-on work was conducted in a development program to design, fabricate, and test a full scale 8000 psi Lightweight Hydraulic System simulator. The principal task was the performance of an additional 600 hours of mission/profile cycling (1200 hours total). Three flight control actuators completed approximately 5 million cycles under simulated aircraft loading. All minor hydraulic components performed satisfactorily. The results demonstrated that 8000 psi hydraulic systems pose no technological problems for aircraft applications. Other tasks completed were ground support equipment re-work, piston seal evaluation test, coil tube design guidelines, black residue investigation, hybrid pump development, and tube fitting re-design. GRA

**N89-14244#** European Space Agency, Paris (France).
**TOUCHSTONE FOR SUCCESS: THE MATERIALS AND PROCESS LABORATORIES**
J. Dauphin, B. D. Dunn, M. D. Judd, F. G. Levadou, A. Zwaal, and Norman Longdon, ed. Jul. 1988 29 p Original contains color illustrations
(ESA-BR-52; ISSN-0250-1589; ETN-89-93585) Copyright Avail: NTIS HC A03/MF A01

The European Space Research and Technology Center is presented including the environmental effects laboratory, the metallic materials laboratory, and the nonmetallic materials laboratory. ESA

**N89-15015*#** National Oceanic and Atmospheric Administration, Boulder, CO.
**SMALL LINEAR WIND TUNNEL SALTATION EXPERIMENTS: SOME EXPERIENCES**
D. A. Gillette and P. R. Owen (Imperial Coll. of Science and Technology, London, England ) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 14B

**N89-15021*#** Arizona State Univ., Tempe.
**DESIGN AND CALIBRATION OF THE CAROUSEL WIND TUNNEL Abstract Only**
R. N. Leach, Ronald Greeley, James D. Iversen, Bruce R. White (California Univ., Davis.), and John R. Marshall *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p Previously announced as N86-27154 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 14B

**N89-15022*#** Arizona State Univ., Tempe.
**DEVELOPMENT AND TESTING OF A UNIQUE CAROUSEL WIND TUNNEL TO EXPERIMENTALLY DETERMINE THE EFFECT OF GRAVITY AND THE INTERPARTICLE FORCE ON THE PHYSICS OF WIND-BLOWN PARTICLES**
R. N. Leach, Ronald Greeley, Bruce R. White, and James D. Iversen (Iowa State Univ. of Science and Technology, Ames.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 6 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 14B

**N89-15039*#** California Univ., Davis.
**AEOLIAN PROCESSES ABOARD A SPACE STATION: SALTATION AND PARTICLE TRAJECTORY ANALYSIS**
Bruce R. White, Ronald Greeley, James D. Iversen, and R. N. Leach (Santa Clara Univ., Calif.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p Previously announced a N86-27165 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 14B

# 12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

**N89-14245*#** National Aeronautics and Space Administration, Washington, DC.
**CURRENT ACHIEVEMENTS IN COSMONAUTICS**
L. A. Yerlykin, ed. Nov. 1988 62 p Transl. into ENGLISH from Novoye v Zhizni, Nauke, Tekhnike: Seriya Kosmonavtika, Astronomiya (USSR), no. 12, 1987 p 1-64 Transl. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASw-4307)
(NASA-TT-20365; NAS 1.77:20365) Avail: NTIS HC A04/MF A01 CSCL 22A

The articles presented in this collection of works tell the latest achievements in Soviet cosmonautics: the regular expedition of cosmonauts to the Mir orbital space station, and the successful development of USSR international cooperation in the sphere of cosmonautics. Information is alo presented on the start of operation of the Japanese booster rocket. Author

# 13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

No abstracts in this category.

# 14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

**N89-14246#** Lawrence Livermore National Lab., CA. Earth Sciences Dept.
**ULTRA-HIGH VELOCITY, HE-DRIVEN PROJECTILE LAUNCHERS**
Lewis A. Glenn 29 Jul. 1988 29 p Presented at the Nuclear Explosives Code Developer's Conference, Boulder, CO, 11-14 Oct. 1988
(Contract W-7405-eng-48)
(DE88-015429; UCRL-99306; CONF-881093-2) Avail: NTIS HC A03/MF A01

A new computer code, called IGUN, has been developed to study the limitations, or constraints on the design, of guns for launching hypervelocity projectiles. IGUN is an arbitrary Lagrange-Eulerian (ALE) code that solves the equations of motion in one dimension, but takes into account arbitrary flow cross section, including discontinuities, and gasdynamic wall drag. The code also features the ability to use pushers with real constitutive models (with strength), generalized tabular equations of state, and a coupled wall motion algorithm that allows gun barrel walls to move in response to the developing internal pressure (conserving momentum and energy in the process). After validating the code with available experimental data, parametric calculations were performed to evaluate the performance of single-stage implosion guns with both hemispherical and Voitenko-like pushers. Preliminary results indicate that a Voitenko device, using helium as the working fluid, and a tested pusher arrangement, can accelerate a projectile to 30 km/s. Potential difficulties and new design concepts are discussed. DOE

**N89-14247*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**POWER SYSTEMS FACILITY**
Jan. 1989 27 p Original contains color illustrations
(NASA-TM-101447; E-4553; NAS 1.15:101447) Avail: NTIS HC A03/MF A01 CSCL 14B

In 1984, the President directed NASA to undertake the development of Space Station Freedom, the next step in a broad-based U.S. civil space program to develop space-flight capabilities and to exploit space for scientific, technological, and commercial purposes. Under that direction, NASA awarded contracts in 1985 for concept definition and preliminary design studies. Those studies have been completed and the Space Station Freedom Program is now in the final design and development phase, leading to a permanently manned space station that will be operational in the mid-1990's. Here at the Lewis Research Center, with Rocketdyne, we are developing and building the S.S. Freedom electric power system (EPS) hardware and software. A major portion of the EPS will be tested at Lewis. The Power Systems Facility was specifically designed for testing the EPS and uses the latest in testing equipment. Author

# 15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

**N89-14248*#** Mississippi State Univ., Mississippi State. Dept. of Electrical Engineering.
**SPACELAB SYSTEM ANALYSIS: A STUDY OF COMMUNICATIONS SYSTEMS FOR ADVANCED LAUNCH SYSTEMS Interim Final Report, Jun. 1987 - Oct. 1988**
Frank M. Ingels, John K. Owens, Steven P. Daniel, F. Ahmad, and W. Couvillion 30 Sep. 1988 208 p
(Contract NAS8-36717)
(NASA-CR-183515; NAS 1.26:183515; MSU-EE-FIN-10B-88)
Avail: NTIS HC A10/MF A01 CSCL 22B

An analysis of the required performance of internal avionics data bases for future launch vehicles is presented. Suitable local area networks that can service these requirements are determined. Author

# 16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

**N89-14249*#** Martin Marietta Aerospace, New Orleans, LA.
**LIQUID ROCKET BOOSTER (LRB) FOR THE SPACE TRANSPORTATION SYSTEM (STS) SYSTEMS STUDY. STUDY PLAN**
Oct. 1987 26 p
(Contract NAS8-37136)
(NASA-CR-179401; NAS 1.26:179401) Avail: NTIS HC A03/MF A01 CSCL 22B

The two major objectives are: to present the study approach, and to provide the standard for guiding the Liquid Rocket Booster (LRB) project. The task plans provide a comprehensive description of the work to be performed. Each plan is presented on a foldout sheet that shows the task description, approach, timeframe, inputs/outputs, manloading, and management lead responsibility. A logic network depicting tasks/subtasks, interrelationships, and time-phasing is described. The milestones and timelines are defined for all tasks and subtasks. Author

# 17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

# 18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

**N89-14250*#** Boeing Aerospace Co., Seattle, WA.
**AEROASSISTED ORBITAL TRANSFER VEHICLE CONTROL TECHNOLOGY Final Report**
M. A. Langehough 26 Aug. 1988 136 p
(Contract NAS8-37358)
(NASA-CR-179424; NAS 1.26:179424) Avail: NTIS HC A07/MF A01 CSCL 22B

The focus of this control has been to develop the control technology required to identify the sophistication required for the Aeroassisted Orbital Transfer Vehicle (AOTV) control system. An angle of attack, bank angle command control technique has been developed which uses either on-off thruster or proportional thruster. An angle of attack adaptive controller was included to minimize the reactor control system (RCS) usage due to payload center of gravity uncertainties. The guidance and control techniques were verified using a detail six degrees-of-freedom simulation. Mission sensitivity was developed for uncertainties in the entry state, mass properties, atmosphere, aerodynamic, and sensor. Author

**N89-14251*#** Boeing Aerospace Co., Huntsville, AL.
**SPACE STATION COMMONALITY ANALYSIS**
[1988] 205 p
(Contract NAS8-36413)
(NASA-CR-179422; NAS 1.26:179422) Avail: NTIS HC A10/MF A01 CSCL 22B

This study was conducted on the basis of a modification to Contract NAS8-36413, Space Station Commonality Analysis, which was initiated in December, 1987 and completed in July, 1988. The objective was to investigate the commonality aspects of subsystems and mission support hardware while technology experiments are accommodated on board the Space Station in the mid-to-late 1990s. Two types of mission are considered: (1) Advanced solar arrays and their storage; and (2) Satellite servicing. The point of departure for definition of the technology development missions was a set of missions described in the Space Station Mission Requirements Data Base. (MRDB): TDMX 2151 Solar Array/Energy Storage Technology; TDMX 2561 Satellite Servicing and Refurbishment; TDMX 2562 Satellite Maintenance and Repair; TDMX 2563 Materials Resupply (to a free-flyer materials processing platform); TDMX 2564 Coatings Maintenance Technology; and TDMX 2565 Thermal Interface Technology. Issues tc be addressed according to the Statement of Work included modularity of programs, data base analysis interactions, user interfaces, and commonality. The study was to consider State-of-the-art advances through the 1990s and to select an appropriate scale for the technology experiments, considering hardware commonality, user interfaces, and mission support requirements. The study was to develop evolutionary plans for the technology advancement missions. Author

**N89-14252#** Interferometrics, Inc., Vienna, VA.
**NAVSPASUR SYSTEM PERFORMANCE ANALYSIS**
E. James Wadiak and Michael D. Andrews 16 Mar. 1988 151 p
(Contract N00014-87-C-2547)
(AD-A198848) Avail: NTIS HC A08/MF A01 CSCL 17G

We have applied a system modelling approach to the problem of projecting the performance of an enhanced NAVSPASUR system. We have modelled the performance characteristics of the current system as well as the out-of-plane station (OOPS) and enhanced signal processing options described in the NAVSPASUR System Development Plan, Phase 2. The objective of this modelling process was to evaluate the ability of NAVSPASUR to provide satellite position and velocity measurements to the accuracy required for first pass orbit determination (FPOD). The FPOD position and velocity requirements have been taken to be 1.67 km and 2 km/min, respectively, as specified in the NAVSPASUR System Development Plan, Phase 1. GRA

**N89-14253#** Naval Ocean Systems Center, San Diego, CA.
**GEOLOCATION VIA SATELLITE: A METHODOLOGY AND ERROR ANALYSIS Final Technical Report, Oct. 1987 - May 1988**
M. J. Shensa May 1988 91 p
(AD-A197955; NOSC/TR-1224) Avail: NTIS HC A05/MF A01 CSCL 25B

This report is directed towards the problem of geolocating the transmitter or receiver of a satellite-relayed signal; however, its methodology is appropriate to general estimation theory. A unified treatment of nonlinear least squares estimation, dominated by techniques for analyzing the estimate accuracy, is presented. In this context, appropriate equations are derived for Doppler measurements as a function of the ground stations and satellite orbit elements. These may be used to determine the satellite orbit as well as ground station locations. A general model for motion on an oblate earth is also developed. GRA

**N89-14254#** Sener S.A., Madrid (Spain).
**TRANSFER AIRLOCK REQUIREMENTS Final Report**
E. Romero, C. Compostizo, J. Escobar, L. Sanchez, E. Cabrera, A. I. Skoog, R. Vaeth, and S. Luck (Dornier-Werke G.m.b.H., Friedrichshafen, Germany, F.R. ) Paris, France ESA Jul. 1987 109 p
(Contract ESTEC-7079/87-NL-PH(SC))
(TAL-RP-SN-003; ESA-CR(P)-2637; ETN-89-93167) Avail: NTIS HC A06/MF A01

A study on the airlock for transfer of crewmen from the future European spacecraft Hermes is presented. A comprehensive set of requirements for each airlock subsystem is derived from literature, mainly from American sources. The comparison among different concepts of airlocks leads to the selection of a preferred concept, or baseline airlock. Important functions, such as hyperbaric chamber or safe haven, though possible with the present concept are, on ESA's directive, not included in the baseline configuration. ESA

**N89-14898*#** Jackson State Univ., MS.MS. Dept. of Technology.
**END-EFFECTOR - JOINT CONJUGATES FOR ROBOTIC ASSEMBLY OF LARGE TRUSS STRUCTURES IN SPACE: A SECOND GENERATION Abstract Only**
W. V. Brewer *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 38-43 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 22B

**N89-14901*#** Lowell Univ., MA. Dept. of Mechanical and Energy Engineering.
**SOME TEST/ANALYSIS ISSUES FOR THE SPACE STATION STRUCTURAL CHARACTERIZATION EXPERIMENT Abstract Only**
Chaur-Ming Chou *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 48-49 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 22B

**N89-14902*#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace Engineering.
**CONTROL OF THE FLEXIBLE MODES OF AN ADVANCED TECHNOLOGY GEOSTATIONARY PLATFORM Abstract Only**
Diane V. DeWalt *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 50 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 22B

**N89-14925*#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
**EXTENSION AND VALIDATION OF A METHOD FOR LOCATING DAMAGED MEMBERS IN LARGE SPACE TRUSSES Abstract Only**
Suzanne Weaver Smith *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 97-98 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 22B

**N89-15004*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**AN OVERVIEW OF THE PROGRAM TO PLACE ADVANCED AUTOMATION AND ROBOTICS ON THE SPACE STATION**
Richard P. Heydorn *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 6 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22B

# 19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

# 20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

**N89-14255*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**LEAKAGE PREDICTIONS FOR RAYLEIGH-STEP, HELIUM-PURGE SEALS**
Margaret P. Proctor Dec. 1988 18 p
(NASA-TM-101352; E-4379; NAS 1.15:101352) Avail: NTIS HC A03/MF A01 CSCL 21H

Rayleigh-step, helium purge, annular shaft seals, studied for use in liquid oxygen turbopumps, generate a hydrodynamic force that enables the seal to follow shaft perturbations. Hence, smaller clearances can be used to reduce seal leakage. FLOWCAL, a computer code developed by Mechanical Technology Incorporated, predicts gas flow rate through an annular seal with an axial pressure gradient. Analysis of a 50-mm Rayleigh-step, helium-purge, annular seal showed the flow rate increased axial pressure gradient, downstream pressure, and eccentricity ratio. Increased inlet temperature reduced leakage. Predictions made at maximum and minimum clearances (due to centrifugal and thermal growths, machining tolerances and + or - 2 percent uncertainty in the clearance measurement) placed wide boundaries on expected flow rates. The widest boundaries were set by thermal growth conditions. Predicted flow rates for a 50-mm Rayleigh-step, helium-purge, annular seal underestimated measured flow rates by three to seven times. However, the analysis did accurately predict flow rates for choked gas flow through annular seals when compared to flow rates measured in two other independent studies. Author

**N89-14256*#** Aerojet TechSystems Co., Sacramento, CA.
**ORBIT TRANSFER ROCKET ENGINE TECHNOLOGY PROGRAM: OXYGEN MATERIALS COMPATIBILITY TESTING Final Report**
Leonard Schoenman Jan. 1989 224 p
(Contract NAS3-23772)
(NASA-CR-182195; NAS 1.26:182195; Rept-CC0134) Avail: NTIS HC A10/MF A01 CSCL 21H

Particle impact and frictional heating tests of metals in high pressure oxygen, are conducted in support of the design of an advanced rocket engine oxygen turbopump. Materials having a wide range of thermodynamic properties including heat of combustion and thermal diffusivity were compared in their resistance to ignition and sustained burning. Copper, nickel and their alloys were found superior to iron based and stainless steel alloys. Some materials became more difficult to ignite as oxygen pressure was increased from 7 to 21 MPa (1000 to 3000 psia). Author

# 23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

# 24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

**N89-14257#** National Bureau of Standards, Gaithersburg, MD. Ceramics Div.
**MECHANICAL PROPERTY ENHANCEMENT IN CERAMIC MATRIX COMPOSITES Interim Report**
S. W. Freiman, T. W. Coyle, E. R. Fuller, Jr., P. L. Swanson, D. C. Cranmer, W. Haller, M. J. Koczak, M. Barsoum, U. V. Deshmukh, and T. R. Palamides (Drexel Univ., Philadelphia, PA.) Apr. 1988 60 p
(Contract N00014-86-F-0096)
(PB88-232863; NBSIR-88-3798) Avail: NTIS HC A04/MF A01 CSCL 11D

The interface strength between AVCO SCS-6 filaments and a borosilicate glass matrix was measured using an indentation push-in technique. Crack-filament interactions were investigated using a fracture mechanics technique (DCDC). An ultraviolet curing technique, coupled with hot pressing was developed to prepare SiC filament-borosilicate glass composites. GRA

**N89-14258*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**METHOD OF INSETTING PREDESIGNED DISBOND AREAS INTO COMPOSITE LAMINATES Patent Application**
George E. Dickerson, inventor (to NASA) 23 Sep. 1988 6 p
(NASA-Case-LAR-13225-1; NAS 1.71:LAR-13225-1;
US-Patent-Appl-SN-248018) Avail: NTIS HC A02/MF A01
CSCL 11D

This invention is a process for producing composite laminates containing interlaminar disbonds of controlled sizes, shapes, and positions within a composite structure. A composite layer is provided for later inclusion within a laminate. The surfaces of this composite layer are solvent cleaned and sandblasted, except in desired disbond areas, which are coated with a releasing surface. A template to mask the bond areas is employed to obtain disbond areas of controlled shapes and sizes. The resulting composite layer is then used in the subsequent manufacture of a laminate, whereby faulty adhesion in the laminate can be studied with prior knowledge of the size, shape, and location of the disbond areas.
NASA

**N89-14259*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**GRAPHITE FLUORIDE FIBER POLYMER COMPOSITE MATERIAL Patent Application**
Ching-Cheh Hung, inventor (to NASA) 30 Sep. 1988 10 p
(NASA-Case-LEW-14472-1; NAS 1.71:LEW-14472-1;
US-Patent-Appl-SN-251499) Avail: NTIS HC A02/MF A01
CSCL 11D

Improved graphite fluoride fibers are produced by contact reaction between highly graphitized fibers and fluorine gas. It is preferable to intercalate the fibers with bromine or fluorine and metal fluoride prior to fluorination. These graphite fluoride fibers are bound by an epoxy. The resulting composites have high thermal conductivity, high electric resistivity, and high emissivity. NASA

**N89-14260#** Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
**CREEP BEHAVIOR OF AN Al2O3-SiC COMPOSITE**
P. Lipetzky, S. R. Nutt (Brown Univ., Providence, RI.), and P. F. Becher 1988 8 p Presented at MRS: High Temperature Composites, Reno, NV, 5 Apr. 1988
(Contract DE-AC05-84OR-21400)
(DE88-014553; CONF-8804181-1) Avail: NTIS HC A02/MF A01

The addition of SiC whiskers to Al2O3 causes significant improvement in mechanical properties, including fracture toughness, thermal shock resistance, and creep resistance. The creep response of a whisker-reinforced alumina composite has been measured using four-point flexural loading at temperatures of 1200 and 1300 C. Composites were fabricated by hot-pressing a blend of alumina powder with 33 vol percent SiC whiskers. The creep data showed a stress-dependent stress exponent equal to 1 at low stress levels and ranging from 4 to 6 at higher stresses. The applied stress at which the transition occurred was temperature dependent and ranged from 30 to 250 MPa. Mechanisms of creep deformation were determined from TEM observations of specimens prepared from interrupted creep tests. Voids were observed at grain boundary-interface junctions in tensile regions and whiskers within the composite were sometimes oxidized where voids had formed. TEM observations from specific stages of steady state creep reached under different applied loads are presented, and the relative contributions of different deformation mechanisms are discussed. DOE

**N89-14261#** Cornell Univ., New York, NY. Dept. of Materials Science and Engineering.
**BONDING AT METAL-CERAMIC INTERFACES IN HYBRID MATERIALS Annual Report, 1 Sep. 1986 - 30 Nov. 1987**
Rishi Raj 30 Jun. 1988 37 p
(Grant AF-AFOSR-0321-86; AF Proj. 2306)
(AD-A197928; AFOSR-88-0768TR) Avail: NTIS HC A03/MF A01 CSCL 11B

The objective of this research project is to investigate the fundamental mechanical properties of the metal-ceramic interface, and to relate those properties to the atomic structure of interface. Until this point we have emphasized the development of innovative techniques for: (1) measuring the shear strength of the interface, and (2) the interfacial energy of the metal-ceramic interface. In the present phase these techniques are being applied to model metal-ceramic systems. The ultimate shear strength of the silica-copper interface has been measured to be in the range 570 MPa to 1670 MPa. This interface had been suspected to be strong but these are the first quantitative measurements of its shear strength. The interfacial energy of the interface is being measured by measuring the contact angle between the metal and the ceramic. It has been found that poor wetting between the copper-alumina interface causes the copper film to become unstable and break up into small spheres. GRA

**N89-14262#** Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Civil Engineering.
**ANALYTICAL AND EXPERIMENTAL CHARACTERIZATION OF DAMAGE PROCESSES IN COMPOSITE LAMINATES Final Report, 1 Sep. 1986 - 29 Feb. 1988**
George J. Dvorak and Norman Laws (Pittsburgh Univ., Pa.) Jun. 1988 126 p
(Grant AF-AFOSR-0366-84; AF Proj. 2302)
(AD-A198068; RPI-CECM-2; AFOSR-88-0707TR) Avail: NTIS HC A07/MF A01 CSCL 11D

This report presents a brief summary of the principal results obtained in a research program on damage development in fibrous composite laminates. The following technical subjects are described: (1) Effect of transverse cracks and fiber breaks on stiffness changes in unidirectional and laminated plates, (2) Effect of ply thickness on initial failure and on progressive cracking in brittle matrix laminates, and (3) Analysis of progressive cracking in metal and polymer composite laminates. Work in progress is discussed as well. GRA

**N89-14263#** Naval Postgraduate School, Monterey, CA.
**DATA ACQUISITION AND CONTROL FOR MULTIPLE COMPOSITE LIFE TESTS M.S. Thesis**
James W. Emery, Jr. Jun. 1988 80 p
(AD-A198395) Avail: NTIS HC A05/MF A01 CSCL 11D

Strength durability of composite materials has many current Navy applications including rocket motor cases, pressure vessel for submarine flasks, energy storage for space applications and for pilot ejection seats. The primary effect of composite aging can be characterized by the fiber filament life under constant stress (stress rupture). This thesis develops experimental facilities for parallel testing of fiber filaments in the form of a bundle. A fast data acquisition system records the filaments breakage during load application. The filaments within a bundle sample are maintained at a constant strain level which is automatically adjusted for creep by digital feedback signal from the load of a control sample. A slow speed data acquisition system records filament breakage during long elapse time (days to years). This thesis establishes a nationally unique capability at the Naval Postgraduate School to quantitatively characterize the reliability of composite material.
GRA

**N89-14264*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**MATERIALS AND STRUCTURES FOR HYPERSONIC VEHICLES**
Darrel R. Tenney, W. Barry Lisagor, and Sidney C. Dixon Oct. 1988 46 p Presented at the 16th Congress of the International Council of Aeronautical Sciences (ICAS), Jerusalem, Israel, 28 Aug. - 2 Sep. 1988 Previously announced in IAA as A89-13542
(NASA-TM-101501; NAS 1.15:101501) Avail: NTIS HC A03/MF A01 CSCL 11D

Hypersonic vehicles are envisioned to require, in addition to carbon-carbon and ceramic-matrix composities for leading edges heated to above 2000 F, such 600 to 1800 F operating temperature materials as advanced Ti alloys, nickel aluminides, and metal-matrix

composited; These possess the necessary low density and high strength and stiffness. The primary design drivers are maximum vehicle heating rate, total heat load, flight envelope, propulsion system type, mission life requirements and liquid hydrogen containment systems. Attention is presently given to aspects of these materials and structures requiring more intensive development. Author

**N89-14929*#** Washington Univ., Seattle. Dept. of Mechanical Engineering.
**THE VISCOPLASTIC BEHAVIOR OF SCS6/Ti-15-3 METAL MATRIX COMPOSITE MATERIALS AT ELEVATED TEMPERATURES Abstract Only**
Mark E. Tuttle *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 103-104 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11D

# 25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

**N89-14265*#** Roberts Associates, Inc., Vienna, Va.
**ANALYSIS OF ELECTROPHORESIS PERFORMANCE Final Report, 21 Feb. 1985 - 30 Jun. 1988**
Glyn O. Roberts 30 Jun. 1988 102 p
(Contract NAS8-36042)
(NASA-CR-183508; NAS 1.26:183508; RAI-88-EL2-4) Avail: NTIS HC A06/MF A01 CSCL 07D

A flexible efficient computer code is being developed to simulate electrophoretic separation phenomena, in either a cylindrical or a rectangular geometry. The code will computer the evolution in time of the concentrations of an arbitrary number of chemical species, and of the temperature, pH distribution, conductivity, electric field, and fluid motion. Use of nonuniform meshes and fast accurate implicit time-stepping will yield accurate answers at economical cost. Author

**N89-14266** New South Wales Univ., Kensington (Australia).
**ELECTROCHEMICAL STUDIES OF MOLTEN GLASS Ph.D. Thesis**
Milena Maric Dec. 1987 3 p
Avail: Issuing Activity

Electrochemical reactions of Ag(I), O sup 2-, Fe(II) and Fe(III) species in molten sodium disilicate glass were investigated by means of cyclic voltammetry, chronopotentiometry and current reversal chronopotentiometry within the temperature range 900 to 1190 C, using reduced and oxidized melts. A three electrode arrangement was employed. The width of the electrochemical window, which at 900 C was -1.2V to 0.2V, decreased with an increase in temperature. It is proposed that Ag(I) reduction involves a reversible diffusion controlled reaction with one electron transfer. Author

**N89-14267** New South Wales Univ., Kensington (Australia). School of Chemical Engineering and Industrial Chemistry.
**MEASUREMENT AND PREDICTION OF MASS TRANSFER IN SOLID CATALYSTS M.S. Thesis**
Gilbert Hei Yin Tang [1988] 2 p
Avail: Issuing Activity

Effective diffusion coefficients for different catalysts of differing pore structure were determined using two different methods. One method was based on steady state counterdiffusion measurement in a diffusion cell, while the other method was based on unsteady state pulse technique employing the single pellet string column. The unsteady state method yielded higher values for effective diffusion coefficients and the reasons for this are discussed. Catalyst pellets with significant macro pore volumes were found to have higher diffusion values. Author

**N89-14268** New South Wales Univ., Kensington (Australia).
**STUDIES OF METAL BETA-DIKETONATES BY REVERSED-PHASE HIGH PERFORMANCE LIQUID CHROMATOGRAPHY M.S. Thesis**
Kevin Malupen Gubag Dec. 1987 3 p
Avail: Issuing Activity

The chromatographic behavior of a selected group of metal beta-diketonates were investigated by studying the differences in the high performance liquid chromatographic properties of copper(II), nickel(II), cobalt(II), zinc(II), iron(III), cobalt(III), chromium(III), and aluminum(III) chelates of a series of homologous beta-diketones. Three beta-diketones and a total of thirty chromatographically pure chelates were synthesized. Small amounts of ligands were incorporated into the mobile phase to observe any effects on the retention time, especially, for any contribution towards suppression of the dissociation of the metal chelates on the column. The results were applied to the analysis of the real sample where the metals were at trace levels. Author

**N89-14269** New South Wales Univ., Kensington (Australia).
**GAS CHROMATOGRAPHIC AND SPECTROSCOPIC STUDIES OF COBALT(II) AND OTHER SELECTED TRANSITION METAL CHELATES OF TETRADENTATE BETA-KETOENAMINES Ph.D. Thesis**
Ashenafi Tessema 1988 3 p
Avail: Issuing Activity

A systematic investigation was made of the gas chromatographic characteristics of Co(II) derivatives of tetradentate beta-ketoenamines and a method was developed intended for the quantification of Co at trace levels. The study involved the preparation and purification of beta-diketones, normal and mixed tetradentate beta-ketoenamines and their Co(II) as well as Ni(II), Cu(II) and oxovanadium chelates. In all, 85 compounds were synthesized. Of these, one beta-diketone, 6 tetradentate beta-ketoenamines, 15 Co(II) chelates and 5 each of Ni(II) and Cu(II) chelates are new. The structures of ligands and chelates were confirmed by microanalysis and spectroscopy, mainly, proton nuclear magnetic resonance and electron impact mass spectroscopy. Volatility and thermal stability of ligands and chelates were examined by thermogravimetric and differential thermal analysis. Non-fluorinated compounds exhibited enhanced thermal stability and volatility compared to the fluorinated analogues, and those derived from 1,2 diaminopropane showed higher volatility than those from 1,2 diaminoethane. Author

**N89-14270#** Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV.
**DETERMINATION OF pH BY FLOW INJECTION ANALYSIS AND BY FIBER OPTRODE ANALYSIS**
Stephen H. Pia, Donna P. Waltman, and Daniel C. Hillman Jul. 1988 55 p
(Contract EPA-68-03-3249)
(PB88-235502; EPA-600/4-88-026) Avail: NTIS HC A04/MF A01 CSCL 07D

Two procedures for measuring pH were developed. The first measures pH colorimetrically using a proprietary indicator dye mixture in a flow injection analysis (FIA) procedure. The second measures pH using a fiber optic chemical sensor (FOCS) specifically developed for pH determinations. The FOCS method measures pH by monitoring the fluorescence of a fluorescein derivative bonded to the distal end of a fiber optic cable called an optrode. The FIA method currently has a precision and accuracy of about + or - 0.2 pH units and can measure 100 samples/hour. The FOCS has a precision of + or - 0.05 to 0.20 pH units and an accuracy of + or - 0.1 to 0.6 pH units. Abount 10 to 60 samples can be analyzed. The characteristics of the FOCS method will vary significantly with individual optrodes. The experimental results indicate that either flow injection analysis or fiber optic

chemical sensor analysis could form the basis for an alternative to electrometric measurement of pH in certain circumstances.
GRA

**N89-14271*#** National Aeronautics and Space Administration, Washington, DC.
**ELECTROCHEMICAL SYNTHESIS OF BARIUM CUPRATE**
A. Yu. Prokopchik and G. I. Rozovskiy Oct. 1988 26 p Transl. into ENGLISH from Lietuvos TSR Mokslu Akad. Darbai (USSR), no. 3, series B, 1961 p 191-194 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20327; NAS 1.77:20327) Avail: NTIS HC A03/MF A01 CSCL 07D

It was shown that during electrochemical oxidation of copper in solutions of barium hydroxide or in NaOh solutions containing Ba(OH)2 a compound of trivalent copper or type Ba(CuO2)2 is formed. The formation of insoluble barium cuprate depends on the concentration of hydroxyl ions and barium ions. With sufficiently high concentrations of these ions, the yield for Cu(3) is the maximum. Based on the findings it is hypothesized that an extremely unstable trivalent copper oxide or hydroxide is initially formed at the anode, which is stabilized by the hydroxyl ions and barium ions contained in the solution. Barium cuprate can also be produced by exchange reaction of barium ions with electrochemically synthesized sodium cuprate. Author

**N89-14272#** Indiana Univ., Bloomington. Dept. of Chemistry.
**A NEW METHOD FOR TRACE METAL DETERMINATIONS BY MONITORING MODULATED MAGNETICALLY INDUCED OPTICAL ROTATION IN ATOMIC VAPOURS**
Curtis A. Monnig and Gary M. Hieftje 11 Jul. 1988 19 p Submitted for publication
(Contract N00014-86-K-0366)
(AD-A198799; INDU/DC/GMH/TR-88-33) Avail: NTIS HC A03/MF A01 CSCL 07B

A new atomic magneto-optical rotation spectrometer (AMORS) for the determination of trace metals is described. This instrument differs from previous AMORS devices by utilizing an electronically variable optical retardation element to modulate polarization and a phase meter for detection of the analytical signal. Preliminary detection limits for Li, K and Mg are comparable to those reported for atomic absorption spectrometry under similar analysis conditions. Furthermore, this novel method of signal detection is insensitive to changes in the light intensity transmitted through the atomizer. Experimental evidence suggests that the spectral bandwidth of the radiation source and the range over which the optical retardation element is varied can significantly affect detection limits. GRA

**N89-14273#** Indiana Univ., Bloomington. Dept. of Chemistry.
**DETECTION OF IONS BY REPLACEMENT-ION CHROMATOGRAPHY COUPLED TO A MICROWAVE-INDUCED NITROGEN DISCHARGE AT ATMOSPHERIC PRESSURE**
Leonard J. Galante, Daniel A. Wilson, and Gary M. Hieftje 11 Jul. 1988 27 p Submitted for publication
(Contract N00014-86-K-0366)
(AD-A198800; INDU/DC/GMH/TR-88-28) Avail: NTIS HC A03/MF A01 CSCL 07D

The capabilities and limitations of replacement-ion chromatography (RIC) employing a lithium-based replacement method and a microwave-induced nitrogen discharge at atmospheric pressure (MINDAP) as the detector are critically evaluated for the determination of anions and cations. The system, including chromatographic columns, interface, and plasma-emission source provides absolute detection limits of 30 to 300 ng for anions and 100 to 500 ng for cations. Detectability and precision of the instrument are ultimately limited by multiplicative noise sources. The limitations imposed by multiplicative noise on RIC detection are assessed, and guidelines are presented that will allow judicious choice of alternative RIC detectors in the future.
GRA

**N89-14274#** Los Alamos National Lab., NM.
**CHEMICAL AND LASER SCIENCES DIVISION Annual Report, 1987**
1988 120 p
(Contract W-7405-eng-36)
(DE88-017140; LALP-88-18) Avail: NTIS HC A06/MF A01

As the Chemical and Laser Sciences Division concludes its first year, the Division personnel can be proud of their many scientific and technical accomplishments. Among the important milestones which the Division achieved were significant demonstrations of the process performance in the Special Isotope Separation program, of beam sensing techniques for the NPB program, and of optical angular multiplexing and energy extraction from the Inertial Confinement Fusion (ICF) KrF laser. In addition, the Los Alamos FTS was brought to operational status and the Bright Source attained intensities on the order of 10 to the 17th power W/cm (2). A few highlights of these and other research and development activities are presented. DOE

**N89-14275#** Pacific Northwest Labs., Richland, Wash.
**FIBER-OPTIC SPECTROCHEMICAL EMISSION SENSORS**
J. W. Griffen, B. S. Matson, K. B. Olsen, D. A. Nelson, and P. A. Eschbach (Washington State Univ., Pullman.) Sep. 1988 15 p Presented at SPIE O-E Lase: International Symposium and Exhibition on Fiber Optics, Optoelectronics and Laser Applications, Boston, MA, 6 Sep. 1988
(Contract DE-AC06-76RL-01830)
(DE88-017175; PNL-SA-16192; CONF-8809105-2) Avail: NTIS HC A03/MF A01

A new class of fiber optic chemical sensor is presently under development at the Pacific Northwest Laboratory. The new probe type, termed fiber optic spectrochemical emission sensor (FOSES), implements either electrical spark or radio frequency excitation (via helium plasma) of analyte species at the probe tip for remote in situ detection. The two excitation modes offer complementary chemical detection methods suitable for vapors, aerosols, or liquid samples. The new probe concept offers the potential for multi-point real-time field sampling and mapping of groundwater contamination plumes or airborne chemical contamination. This paper addresses probe designs, probe characteristics and performance, detection limits, and future concepts for multi-point sampling systems.
DOE

**N89-14276#** Florida Univ., Gainesville. Dept. of Chemistry.
**DEVELOPMENT OF LASER-EXCITED MOLECULAR LUMINESCENCE SPECTROMETRIC METHODS FOR AROMATIC HYDROCARBONS Progress Report, 1 Mar. 1987 - 29 Feb. 1988**
J. D. Winefordner 1988 7 p
(Contract DE-FG05-87ER-60501)
(DE88-017305; DOE/ER-60501/1) Avail: NTIS HC A02/MF A01

Considerable progress was made in the areas of chemiluminescence in low pressure discharges, a self cleaning, continuous cooling belt for low temperature molecular luminescence spectrometry, the importance of the multiplex disadvantage with respect to excess low frequency noise, and electrothermal vaporization with laser excited fluorescence as a means of screening polycyclic aromatic hydrocarbons in air particulates. DOE

**N89-14277#** Sandia National Labs., Albuquerque, N. Mex.
**A SOLAR PHOTOCHEMICAL PROCESS FOR DESTROYING ORGANICS IN WATER**
J. T. Holmes and C. A. Haslund 1988 13 p Presented at the 4th Annual DOE Model Conference, Oak Ridge, TN, 3 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE89-000503; SAND-88-1235C; CONF-881054-6) Avail: NTIS HC A03/MF A01

Recent scientific literature indicates the potential benefits of using photocatalytic oxidation reactions for the destruction of organic contaminants in water. The processes utilize solid or dissolved photon-activated catalysts to break down low

concentrations of hazardous organic chemicals into carbon dioxide and simple acids. We are using concentrated sunlight to study a falling-liquid-film reactor that has the characteristics to effectively conduct these photochemical reactions. These include the ability to utilize high solar (photon) flux densities without overheating or evaporating the fluid or contaminants; excellent interactions, in the thin film of fluid, between concentrated sunlight, catalyst and contaminants in the fluid; the fluid is easily doped with reactants and solid or dissolved catalysts; high capacity; and easy process control. We investigated the maximum solar power capabilities of a pilot-scale (1m X 3.5m) falling-water-film reactor. Our thermal performance results indicate its potential as a photochemical reactor. DOE

**N89-14278#** Waterloo Univ. (Ontario). Dept. of Chemistry.
**THE SURFACE ENHANCED RAMAN SCATTERING OF THE PROTONATED FORMS OF DABCO AT A SILVER ELECTRODE Technical Report No. 2, Jan. 1987 - Aug. 1988**
David A. Guzonas, Donald E. Irish, and George F. Atkinson 8 Aug. 1988 48 p
(Contract N00014-87-J-1118)
(AD-A197930) Avail: NTIS HC A03/MF A01 CSCL 07D

The Surface Enhanced Raman Spectra of the aliphatic diamine 1.4 diazabicyclo2.2.2octane (DABCO) from a silver electrode have been measured as a function of the bulk solution pH. The SER spectrum of the diprotonated DABCO molecule at pH = 1.8 is almost identical to the normal Raman spectrum of the bulk solution at the same pH, in contrast to the SER spectrum of the unprotonated DABCO molecule at pH=12, which shows large differences from the spectrum of the bulk solution at pH = 12. It is proposed that the diprotonated DABCO molecule is co-adsorbed with specifically adsorbed anions, e.g., CT, and that its spectrum is enhanced by the electromagnetic enhancement mechanism alone. At intermediate pH values, all three possible forms (di, mono and unprotonated) of DABCO are observed, in amounts strongly dependent upon the electrode potential. Both band deconvolution and factor analysis were used to quantify relative populations. GRA

**N89-14279#** Oregon Univ., Eugene. Dept. of Chemistry.
**POWERFUL PHOTOGENERATED REDUCING AGENTS Final Report, 1 Apr. 1986 - 31 Mar. 1988**
David Tyler 1 Jul. 1988 13 p
(Grant AF-AFOSR-0081-86; AF Proj. 2303)
(AD-A197949; AFOSR-88-0743TR) Avail: NTIS HC A03/MF A01 CSCL 07E

An investigation of the reducing abilities of photochemically-generated 19-electron complexes was accomplished. The investigation had four primary objectives: (1) study the capabilities and limitations of the 19-electron complexes as reducing agents; (2) synthesize or produce water-soluble 19-electron complexes; (3) recycle the 19-electron reducing agents so as to make these species catalytic reductants; and (4) use the 19-electron reductants to perform chemically interesting transformations. GRA

**N89-14280#** Naval Research Lab., Washington, DC.
**ADSORPTION OF CHLORINE ON CLEAN AND ON OXYGEN PRE-EXPOSED Al(3) Technical Report No. 5, Oct. 1986 - Sep. 1987**
V. M. Bermudes and A. S. Glass 1 Aug. 1988 21 p
(AD-A198005) Avail: NTIS HC A03/MF A01 CSCL 11F

The adsorption of Cl2 (chlorine) on clean and on O2 (oxygen) pre-exposed Al(3) (aluminum) has been studied using Auger and electron energy loss spectroscopies, low energy electron diffraction, temperature programmed desorption and work function measurement. Near room temperature chlorine forms a disordered layer in a two-step process consisting of adsorption at surface sites, dominating at low exposure, followed by population of subsurface sites at higher exposure. Surface adsorption is characterized by a sticking coefficient of about 0.1, an increase in work function of about 1 eV and a desorption peak at about 200 C. The subsurface phase exhibits a smaller sticking coefficient and work function change and no distinct desorption peak. Pre-absorbed O blocks formation of subsurface species but not those formed in the initial adsorption step. Cl2 does not displace pre-absorbed O, but O2 displaces some subsurface Cl. Chlorination is found to occur inhomogeneously rather than uniformly in a layer-by-layer mode. GRA

**N89-14281#** Dayton Univ., OH. Research Inst.
**DYNAMIC COMBUSTION STUDIES USING ADVANCED OPTICAL DIAGNOSTICS. VOLUME 2: TABULATED DATA Final Report, 21 Feb. 1983 - 20 Oct. 1987**
D. R. Ballal, T. H. Chen, A. J. Lightman, W. J. Schmoll, and P. P. Yaney Jul. 1988 69 p
(Contract F33615-82-C-2255)
(AD-A198025; UDR-TR-88-02-Vol-2; AFWAL-TR-88-2034-Vol-2)
Avail: NTIS HC A04/MF A01 CSCL 21B

Computer models of turbulent mixing and combustion suffer from many limitations, deficiencies, and errors. To evaluate and refine them, an experimental research program was started: (1) to develop a combustion test facility and optical diagnostics, (2) to perform turbulent mixing and combustion experiments, and (3) to provide a data base for modeling needs. In Volume 2, bench-mark quality data recorded in these experiments are documented for modeling needs. Specifically, data are tabulated for three variable-density, non-reactive turbulent mixing experiments: (1) 2-D Mixing Layer, (2) 2-D Slot Jet/Centerbody, and (3) Round Jet, and for two turbulent combustion experiments: (1) Scalar Fluctuations in Premixed Flames, (2) Conical Flame Stabilizer. These data may be used to evaluate and refine modeling codes of turbulent mixing and combustion processes. GRA

**N89-14282#** Columbia Univ., New York, NY. Radiation Lab.
**SPONTANEOUS AND INDUCED COHERENT RADIATION GENERATED IN ATOMIC VAPOR Final Report, 1 Jun. 1978 - 31 May 1988**
Sven R. Hartman 28 Jul. 1988 9 p
(Contract N00014-78-C-0517)
(AD-A198060) Avail: NTIS HC A02/MF A01 CSCL 20E

Optical coherent techniques have been developed and applied in order to obtain relaxation and spectroscopic information in atomic vapors. Theoretical work was performed to understand collisional relaxation and the interaction of intense fields with matter. The utility of using incoherent light fields in generating coherent excitations was demonstrated and analyzed. Applications of the time delayed four wave mixing technique using broadband light for investigating relaxation in solids have begun. GRA

**N89-14283#** California Univ., San Diego, La Jolla.
**FIREFLY LUCIFERASE-STRUCTURE AND FUNCTION Final Report, 1 Jun. 1986 - 31 May 1988**
William D. McElroy 1 Jun. 1988 4 p
(Contract N00014-86-K-0267)
(AD-A198292; UCSD-88-5722) Avail: NTIS HC A02/MF A01 CSCL 06B

In order to better understand the enzymatic structure and function of firefly luciferase, the cDNA encoding this protein was recently cloned. In this report we present the extension of our earlier work with the cloning of several luciferases from a bioluminescent click beetle (Pyrophorus plagiophthalamus). The luciferases of this beetle produce bioluminescence of different colors. We isolated 13 cDNA clones which were capable of producing luminescence in E. coli of four different colors: green, yellow-green, yellow, and orange. The amino acid sequence of these luciferases are approximately 96 percent identical with each other, but are less than 50 percent identical with the firefly luciferase. GRA

**N89-14284#** California Univ., Davis.
**AERODYNAMIC AND KINETIC PROCESSES IN FLAMES Annual Report, 1 Mar. 1987 - 29 Feb. 1988**
Chung K. Law 1 May 1988 4 p
(Grant AF-AFOSR-0147-85; AF Proj. 2308)

(AD-A198474; AFOSR-88-0900TR) Avail: NTIS HC A02/MF A01 CSCL 21B

The flame response in realistic situations is governed by the detailed kinetics of chemical reactions, the diffusion of heat and mass, and the aerodynamic processes of stretching, turbulence, and large-scale flow nonuniformity. During the reporting period good progress was made in the areas of turbulent flame propagation, soot formation in diffusion flames, and experimental and numerical determination of the laminar flame speeds of methane/air mixtures under reduced and elevated pressures. GRA

**N89-14285#** Yale Univ., New Haven, Conn.
**THE DETECTION AND STUDY OF MOLECULAR SPECIES USING TIME RESOLVED LASER SPECTROSCOPY Final Report, 14 Apr. 1985 - 14 Apr. 1988**
Steven D. Colson Jul. 1988 14 p
(Contract DAAG29-85-K-0103)
(AD-A198482; ARO-22561.10-CH) Avail: NTIS HC A03/MF A01 CSCL 07C

The detection of trace components in the atmosphere and contaminants or other active agents in or on support facilities is of primary importance to the protection of military personnel. One proposed approach relies upon the decomposition of the agent followed by the detection of characteristic fragments. This allows highly sensitive, remote spectroscopic techniques to be used for the analysis. In the design of propellants, it is important to be able to characterize and study their primary decomposition products. This also creates a need for the remote detection of molecular fragments, many of which are not well studied chemical species. The purpose of this basic research effort will be to identify and characterize small molecular fragments formed from the decomposition of model compounds. It is hoped that the results of such research will form the genesis for nondestructive, quantitative analysis methods under field conditions requiring either remote or point sensing. GRA

**N89-14286#** California Univ., Berkeley. Dept. of Chemistry.
**TRANSIENT BEHAVIORS IN CHEMICAL REACTIONS: NANOSECOND INFRARED SPECTROSCOPY, CHEMICALLY PUMPED VISIBLE AND NEAR-IR LASERS Final Report, Nov. 1986 - Oct. 1987**
George C. Pimentel Jun. 1988 5 p
(Grant AF-AFOSR-0044-87; AF Proj. 2917)
(AD-A198484; AFOSR-88-0862TR) Avail: NTIS HC A02/MF A01 CSCL 09C

An excimer laser with pulse duration of 28 ns FWHM and average power at 248 nm of 530 mj per pulse was purchased and used as a photolysis source to accompany an existing nanosecond infrared spectrometer. With this system, transient molecular species with lifetimes as short as ten nanoseconds can be investigated. Gaseous CF31 was photolyzed to produce CF3 radicals whose infrared spectra around 1250 wavenumbers were taken at selected delay times. At very short delays highly vibrationally excited radicals are found, and a measure of vibrational relaxation rates can be made. GRA

**N89-14287#** Arizona Univ., Tucson. Dept. of Chemistry.
**THE FUTURE OF INTELLIGENT SPECTROMETERS IN METAL SPECIATION BY ATOMIC EMISSION SPECTROMETRY**
M. B. Denton and R. B. Bilhorn 4 Feb. 1988 4 p
(Contract N00014-86-K-0316)
(AD-A198592; TR-56) Avail: NTIS HC A02/MF A01 CSCL 20E

Powerful new analytical capabilities are becoming available as the result of coupling various separation techniques with modern atomic spectrometry. These approaches can provide the analyst with tremendous insight into the elemental composition of each eluding constituent. The very factors which allow atomic emission to provide element specific detection for virtually the entire periodic table, can cause major problems when trying to apply the technique to separation techniques such as gas and liquid chromatography. The resulting transient signals and background effects over a large wavelength region, coupled with the relatively narrow atomic line band width, present problems in both detection and data manipulation. These problems are reviewed, and various potential solutions considered. A new approach which holds great promise for handling these problems will be presented. This technique employs array detectors capable of simultaneously observing a very large number of wavelengths, providing analysis, background, and diagnostic data. When used in conjunction with appropriate software, an entirely new dimension of intelligent instrument becomes possible. Operational capabilities of such instrumentation are presented, including data from a variety of chemical systems. GRA

**N89-14288#** Arizona Univ., Tucson. Dept. of Chemistry.
**MOLECULAR SPECTROSCOPY USING CHARGE TRANSFER DEVICE DETECTORS Technical Report No. 58**
Jonathan V. Sweedler, M. B. Denton, P. M. Epperson, and R. D. Jalkian 4 Feb. 1988 4 p
(Contract N00014-86-K-0316)
(AD-A198593) Avail: NTIS HC A02/MF A01 CSCL 07D

Recent advances in the capabilities of state-of-the-art array detectors have the potential to greatly improve analytical spectroscopy. The operational characteristics of several charge transfer device (CTD) detectors investigated in our laboratories show them to be highly suitable for application in UV-Vis molecular spectroscopy. The electro-optical characteristics of these devices including dynamic range, quantum efficiency, noise, resistance to blooming and lag are contrasted to photodiode arrays, vidicons, and photomultiplier tubes. With peak quantum efficiencies of 80 percent, read noises over two orders of magnitude lower than photodiode array detectors, and virtually no dark current, several of these CTD detectors are extremely well suited for luminescence spectroscopy. The performance of several spectroscopic systems which effectively use the various device geometries is presented. A linear concave grating spectrograph employing a 30-watt deuterium source and a CTD detector capable of extremely sensitive fluorescence measurements is described. GRA

**N89-14289#** Technische Hogeschool, Eindhoven (Netherlands).
**TRACE ANALYSIS BY CAPILLARY GAS CHROMATOGRAPHY: THEORY AND METHODS Ph.D. Thesis**
Theodorus Henricus Noij 1988 192 p
(B8811770; ETN-89-93346) Avail: NTIS HC A09/MF A01

Methods are presented for the quantitative analysis of trace concentrations of organics in air and water in order to answer to an increasing demand for the analysis of very low concentrations of organic compounds in complex samples. The theory of the influence of the chromatographic parameters on the detection of trace compounds is discussed. Dynamic headspace sampling is found to be a very suitable technique for the trace analysis of volatile organic compounds in water. Purging at high temperature drastically improves the recovery of slightly polar compounds. ESA

**N89-14345*#** Massachusetts Inst. of Tech., Cambridge.
**RESIDUAL INFRARED ABSORPTION IN Ti:Al2O3 CRYSTALS**
*In its* Solid State Research 11 Mar. 1988 p 23-30 (For primary document see N89-14342 06-31)
Avail: NTIS HC A04/MF A01 CSCL 13B

**N89-14913*#** Missouri Univ., Rolla. Dept. of Aerospace Engineering.
**MODELING OF HYDROGEN-AIR DIFFUSION FLAME Abstract Only**
Kakkattukuzhy Isaac *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 71 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 21B

**N89-14930*#** Old Dominion Univ., Norfolk, Va. Dept. of Chemical Sciences.
**PRETREATMENT OF CO OXIDATION CATALYSTS Abstract Only**
John D. VanNorman *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 105 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 07D

**N89-15014*#** Texas A&M Univ., College Station. Dept. of Geology.
**VOLATILIZATION-DEVOLATILIZATION REACTIONS**
M. C. Gilbert, D. M. Anderson, A. Hajash, E. Hoskins, and R. K. Popp *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 07D

**N89-15028*#** Carnegie Institution of Washington, DC. Geophysical Lab.
**CRYSTAL-LIQUID-VAPOR EQUILIBRIUM EXPERIMENTS AT HIGH TEMPERATURE (LESS THAN OR EQUAL TO 1800 C) AND LOW, CONTROLLED OXYGEN AND HYDROGEN PRESSURE (10(-1) TO 10(-9) PA)**
B. O. Mysen *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 07D

**N89-15031*#** National Aeronautics and Space Administration, Washington, DC.
**ULTRAVIOLET SPECTROSCOPY OF METEORIC DEBRIS: IN SITU CALIBRATION EXPERIMENTS FROM EARTH ORBIT**
Joseph A. Nuth, Thomas J. Wdowiak, and William R. Kubinec (Charleston Coll., SC.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p Previously announced as N86-27159 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 07D

**N89-15044*#** Arizona Univ., Tucson. Dept. of Planetary Sciences.
**EXPERIMENTAL CORRELATION OF MELT STRUCTURES, NUCLEATION RATES, AND THERMAL HISTORIES OF SILICATE MELTS Abstract Only**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 07D

# 26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

**N89-14290** Brunel Univ., Uxbridge (England).
**TRIBOLOGICAL CHARACTERISTICS OF COATINGS ON ALUMINIUM AND ITS ALLOYS Ph.D. Thesis**
Fadhil S. Abdul-Mahdi 1987 231 p
Avail: Univ. Microfilms Order No. BRDX81393

Hard anodizing on aluminum and its alloys was widely practiced for many years in order to improve the resistance of the otherwise poor wear characteristics of aluminum. In recent years there is an increasing interest in other treatments and coatings, on both aluminum and other base metals. The aim is to explain the tribological performance and wear mechanism(s) of an uncoated aluminum alloy, four anodic coated alloys, and also an electroless nickel alloy. In an endeavor to explain the role of coating thickness on wear life, electroless nickel alloy was produced in a range of thicknesses of 10, 20, and 30 microns. To evaluate abrasive and adhesive wear, the samples were rubbed against a single point diamond and steel ball, respectively, in a reciprocating movement at room temperature and 65 to 75 percent relative humidity, under a wide range of load and sliding distance. Abrasive wear was performed under dry conditions, whereas, adhesive wear was evaluated under both dry and lubricated conditions. These coatings predominately fail by adhesion, plastic deformation, and brittle fracture. A microscopic model for fracture of brittle materials, under both static and dynamic conditions for abrasive and adhesive wear correlates very well with the behavior of these coatings. Analytical interpretation of adhesive wear was made by separately calculating the coefficient of wear K of the counterbodies. This information enables an improved understanding of the wear test itself to be added to the model of the wear mechanisms involved.
Dissert. Abstr.

**N89-14291** New South Wales Univ., Kensington (Australia). School of Materials Science and Engineering.
**THE DEVELOPMENT OF IRON-ALUMINIUM BASED ALLOYS FOR AQUEOUS CORROSION RESISTANCE Ph.D. Thesis**
Rosie Rong Ling Wang Jan. 1988 2 p
Avail: Issuing Activity

The passivation behavior of a series of Fe- (5-15)Al- (0-15)Cr- (0-25)Mn alloys in one normal sulphuric acid was examined. The addition of aluminum to the alloys was found to improve the passivity of iron based alloys. However, in the binary Fe-Al alloys no significant beneficial effect on the passivation behavior was found until a minimum of 10 Wt percent aluminum was present. Within the studied composition range, aluminum and chromium showed wide interchangeability. Manganese did not show any beneficial effect in developing passivity and more than 15 Wt percent manganese had a detrimental effect. The addition of a small amount of molybdenum evidently deceased the critical current density of Fe-Al alloys. As a result, an optimum alloy composition was selected as Fe-10Al-5Cr-2.5Mo. The passive properties of this alloy in 1N $H_2SO_4$ and 3.5 percent NaCl solutions are comparable with those of Type 304 stainless steel. The effect of selective dissolution of iron on the passivation process of iron based alloys is discussed. The effect of electron configuration on passive properties of Fe-Al and Fe-Al-Cr alloys were also considered.
Author

**N89-14292#** Sandia National Labs., Albuquerque, N. Mex.
**MONOCHROMATIC IMAGING STUDIES OF A LOW PRESSURE ARC BURNING ON MOLTEN INCONEL 718 ALLOY ELECTRODES DURING VACUUM ARC REMELTING**
R. L. Williamson, F. J. Zanner, and W. A. Hareland 1988 17 p Presented at the 9th International Vacuum Metallurgy Conference on Special Melting, San Diego, CA, 11 Apr. 1988
(Contract DE-AC04-76DP-00789)
(DE88-012855; SAND-87-2582C; CONF-8804182-1) Avail: NTIS HC A03/MF A01

Vacuum arc remelting (VAR) is a melting and solidification process used to produce high quality ingots of chemically reactive or segregation sensitive alloys. Melting is accomplished through the use of a sustained high current (several kiloamperes) dc arc. Energy from the arc is used to melt a consumable electrode (cathode) which is cast from the alloy to be remelted. The molten material drips down into a water-cooled copper crucible (anode) where it solidifies as a larger diameter, homogeneous, porosity-free, cylindrical ingot. Solidification is driven mainly by radial heat extraction from the molten pool atop the ingot and is influenced by magnetically and buoyancy driven fluid flows that are coupled to the arc behavior. The paper reports the initial results of efforts to characterize the VAR furnace arc during remelting of Inconel 718 alloy using monochromatic imaging. This technique allows one to examine how individual atomic species are distributed throughout the arc plasma in the electrode gap. Because only species existing in excited electronic states are able to emit light, the images also give insight into the energy distribution in the gap. Chromium and manganese distributions were investigated.

Chromium was chosen to represent one of the major alloy constituents, while manganese represents a highly volatile trace component. DOE

**N89-14293#** Florida Univ., Gainesville. Dept. of Materials Science and Engineering.
**IMPLANTATION STUDIES OF HYDROGEN BY FIELD ION MICROSCOPY AND SPECTROSCOPY Ph.D. Thesis. Final Report**
E. D. Verink, R. T. DeHoff, and J. J. Hren 15 Jan. 1988 209 p
(Contract DE-FG05-84ER-45172)
(DE88-016020; DOE/ER-45172/T2) Avail: NTIS HC A15/MF A01

For both fundamental and applied research in materials science there is widespread interest in ion implantation. This is particularly true in the field of tribology where the study of surface wear during sliding contact is especially important. The depth resolution of the Field Ion Microscope/Imaging Atom Probe (FIM/IAP) is of the order of a crystal d-spacing of the metal under investigation. The current study involves the application of the FIM/IAP to the study of low energy ions (less than 20 keV) implanted into nickel and tungsten to obtain depth profiles. Two ion species of immense technological importance were used, nitrogen and deuterium. Results of this investigation fall into four categories: (1) instrumentation development; (2) development of new experimental techniques; (3) the generation and interpretation of experimental data; and (4) the determination of a number of characteristics of FIM which can influence the interpretation of experimental observations. DOE

**N89-14294#** Arizona Univ., Tucson.
**GRAIN BOUNDARY PHASE EQUILIBRIA IN METALLIC SYSTEMS Progress Report, 1 Dec. 1987 - 30 Nov. 1988**
P. Deymier, M. Shamsuzzoha, V. Campos, and H. Evans Aug. 1988 16 p
(Contract DE-FG02-87ER-45285)
(DE89-000026; DOE/ER-45285/2) Avail: NTIS HC A03/MF A01

A combined experimental and theoretical approach to treating the problem of grain boundary phase equilibrium is presented. On the theoretical side, volume dependent interionic potentials have been generated. A sigma = 5 bicrystal has been simulated with the constant pressure molecular dynamics method. The melting of the grain boundary before the bulk has been investigated. A liquid like layer replaces the solid interface at 1200 K. The disordering occurs above the bulk melting point. The slow kinetics of the process is thought to be the limiting factor for observing the phenomenon at lower temperatures. Analytical expressions for the elastic energy of a point defect near a general high angle grain boundary have been derived. These expressions predict two mechanisms for segregation: uniform segregation in the core of the grain boundary or formation of aggregates. On the experimental side, we have used strain annealing to grow large random bicrystals of 99.999 percent pure aluminum. Strain annealing and float zone refining are investigated as potential growth techniques for producing bicrystals with controlled misorientation. The procedure for preparing electron-transparent bicrystal specimens from the as grown large bicrystal is reported. We present the transmission electrons microscopy work preliminary to the high resolution microscopy on a symmetric near sigma = 3 grain boundary. DOE

**N89-14295#** Academy of Sciences of the Ukrainian SSR, Kharkov.
**DIMOD PROGRAM COMPLEX FOR DYNAMIC SIMULATION OF DEFECTS IN METALS AND ALLOYS**
V. V. Gann and I. G. Marchenko 1987 10 p In RUSSIAN
(DE88-703787; KFTI-87-24) Avail: NTIS (US Sales Only) HC A02/MF A01

Computational program complex for dynamic simulation of defects in metals and alloys is described. The program complex may be used for solution of a wide range of problems in solid physics: study of point, linear and plane defect properties, calculation of nonequilibrium phonon states in a crystal, simulation of radiation-induced defects. All programs are highly flexible and fast-acting. Examples of applying the program complex for solving concrete problems in physics of radiation damages are presented. DOE

**N89-14296#** Sandia National Labs., Albuquerque, N. Mex.
**MECHANICAL PROPERTIES OF DISPERSION STRENGTHENED COPPER: A COMPARISON OF BRAZE CYCLE ANNEALED AND COARSE GRAIN MICROSTRUCTURES**
J. J. Stephens, R. J. Bourcier, F. J. Vigil, and D. T. Schmale Sep. 1988 58 p
(Contract DE-AC04-76DP-00789)
(DE89-001061; SAND-88-1351) Avail: NTIS HC A04/MF A01

The tensile properties of a commercial oxide dispersion strengthened copper alloy (Glidcop A1-15, Low Oxygen Grade) have been studied at both room temperature and elevated temperatures in various microstructural conditions. The alloy has been examined in various fine grained conditions with highly elongated grains and substantial amount of cold work, as well as a coarse grained condition obtained using secondary recrystallization. The fine grained specimen conditions included the as-extruded condition, a thermal cycle of 5 minutes at 980 C, appropriate for a simulated Ti-Cu-Ni braze cycle, and an extended Ti-Cu-Ni braze thermal cycle of 15 minutes at 980 C. The coarse grained condition was obtained by a long term anneal, i.e., 100 hrs at 1040 C. The results for room temperature tests indicated that the two braze thermal cycles had only a small effect on both yield and tensile strength, but did realize small increases in ductility, compared to the as-extruded condition. However, the coarse-grained condition exhibited significant decreases in both yield and tensile strength, along with a large ductility increase. Both optical metallography and scanning electron microscopy were used in order to understand the changes observed in strain to fracture and fracture mode at the various temperatures. The room temperature fracture surfaces all exhibited classic ductile rupture with dimpled fracture surfaces. The fracture surfaces at higher temperatures and slower strain rates exhibited an increased tendency to fracture with some grain boundary void formation. DOE

**N89-14297*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**OXIDATION BEHAVIOR OF FeAl+Hf,Zr,B**
James L. Smialek and Joseph Doychak (Sverdrup Technology, Inc., Cleveland, Ohio.) 1988 15 p Presented at the Workshop on the Oxidation of High-Temperature Intermetallics, Cleveland OH, 22-23 Sep. 1988; sponsored by ASM and TMS AIME Case Western Reserve Univ., AIME and TMS-AIME
(NASA-TM-101402; E-4486; NAS 1.15:101402) Avail: NTIS HC A03/MF A01 CSCL 11F

The oxidation behavior of Fe-40Al-1Hf, Fe-40Al-1Hf-0.4B, and Fe-40Al-0.1Zr-0.4B (at. percent) alloys was characterized after 900, 1000, and 100 C exposures. Isothermal tests revealed parabolic kinetics after a period of transitional theta-alumina scale growth. The parabolic growth rates for the subsequent alpha-alumina scales were about five times higher than those for NiAl+0.1Zr alloys. The isothermally grown scales showed a propensity toward massive scale spallation due to both extensive rumpling from growth stresses and to an inner layer of HfO2. Cyclic oxidation for 200 1-hr cycles produced little degradation at 900 or 1000 C, but caused significant spallation at 1100 C in the form of small segments of the outer scale. The major difference in the cyclic oxidation of the three FeAl alloys was increased initial spallation for FeAl+Zr,B. Although these FeAl alloys showed many similarities to NiAl alloys, they were generally less oxidation resistant. It is believed that this resulted from nonoptimal levels of dopants and larger thermal expansion mismatch stresses. Author

**N89-14298#** Naval Ship Research and Development Center, Bethesda, MD. Ship Materials Engineering Dept.
**ANALYSIS OF DUCTILE-BRITTLE TRANSITION TEMPERATURES FOR CONTROLLED-ROLLED, MICROALLOYED, C-Mn-BASED STEELS Report, Dec. 1986 - Dec. 1987**
R. W. Armstrong, L. R. Link, and G. R. Speich May 1988 25 p (AD-A198132; DTRC/SME-88-30) Avail: NTIS HC A03/MF A01 CSCL 11F

Charpy V-notch ductile-brittle transition temperatures reported for a conventional carbon manganese steel and for several controlled-rolled microalloyed steels are compared with transition temperatures computed on a dislocation model basis. The computed transition temperature, Tc, is specified by equating the tensile cleavage fracture stress and the effective yield stress at the Charpy V-notch. Increased friction stress resistances to dislocation movement provided by solutes, precipitates, and other dislocations raise the yield stress and, thereby, increase Tc. A residual dislocation based friction stress resistance occurs within untransformed ferrite grains (that is, the ferrite present at the rolling temperature) when finish rolling is done in the austenite-ferrite region. Grain size refinement normally lowers Tc because the cleavage stress is increased to a greater extent than is the yield stress. GRA

**N89-14299#** Army Lab. Command, Watertown, MA. Material Technology Lab.
**LOW TEMPERATURE HEAT CAPACITIES OF SEVERAL HIGH STRENGTH MATERIALS Final Report**
James C. Ho and Dattatraya P. Dandekar Jul. 1988 14 p (AD-A198300; MTL-TR-88-23) Avail: NTIS HC A03/MF A01 CSCL 11F

Low temperature calorimetric measurements have been made on three metallurgically prepared high strength materials: NiAl, W-2 (a heavy tungsten alloy), and Al-Fe-Ce (a lightweight alloy with dispersion strengthening). To fit the heat capacity data between 3 and 10 K, not only the electronic and lattice contributions having T and T3 dependence, respectively, need to be considered, there is an additional temperature-independent term presumably associated with magnetic clusters. These results provide information on the fundamental characteristics, as well as the heterogeneous nature of the materials not always detectable by standard metallurgical techniques. GRA

**N89-14300#** Georgia Inst. of Tech., Atlanta. School of Materials Engineering.
**CYCLIC DEFORMATION, DAMAGE, AND EFFECTS OF ENVIRONMENT IN THE Ni3Al ORDERED ALLOY AT ELEVATED TEMPERATURES Annual Report, 1 May 1987 - 1 May 1988**
Stephen D. Antolovich 1 May 1988 8 p
(Grant AF-AFOSR-0162-87; AF Proj. 2306)
(AD-A198500; AFOSR-88-0578TR) Avail: NTIS HC A02/MF A01 CSCL 11F

A basic program is defined to investigate cyclic deformation, damage accumulation, and fatigue crack propagation (FCP) In the ordered Ni3Al system as affected by composition, temperature, and environment. While this class of ordered alloys shows great promise for elevated temperature applications in jet and rocket engines, problems of brittleness and damage by hostile environments have been encountered in monotonic tensile deformation. The basic mechanisms of cyclic deformation and fatigue crack propagation have not been fully investigated; yet must be understood if these materials are to be used in advanced applications. GRA

**N89-14301** National Physical Lab., Teddington (England). Div. of Materials Applications.
**ANALYSIS OF HYDROGEN DIFFUSION AND TRAPPING IN A 13 PERCENT CHROMIUM MARTENSITIC STAINLESS STEEL**
A. Turnbull, M. W. Carroll, and D. H. Feriss Jun. 1988 19 p (NPL-DMA(A)-158; ISSN-0143-7313; ETN-89-93573) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

The combined effects of reversible and irreversible trapping, with varying degrees of occupancy, on hydrogen transport in steels were analyzed. Analysis was coupled with repetitive electrochemical permeation measurements to characterize the diffusion and trapping parameters associated with a 13 percent Cr martensitic stainless steel commonly used for oil production tubing. The density of reversible and irreversible traps is (3.0 plus or minus 1.0) times 10 to the 19th power sites/cc and 1.5 times 10 to the 19th power sites/cc respectively. The binding energy of the reversible traps is (minus 38.7 plus or minus 1.0) kJ/mol. The capture rate constant for the irreversible traps is (4.8 plus or minus 1.3) times 10 to the 19th power/cc/sec. Assuming the same value for the reversible traps yields a release rate constant for the reversible traps of (3.4 plus or minus 1.6) x 0.1/sec. Knowledge of these parameters enables improved calculation of hydrogen charging times, which is essential for establishing reliable test methodology. It is recommended that the use of an effective diffusion coefficient be abandoned in systems for which irreversible trapping is dominant. ESA

**N89-14302#** California Univ., Los Angeles.
**TERNARY SOLID PHASE EQUILIBRIA IN THE SYSTEMS (Ag,In,Au)-(Cd,He)-Te Report No. 6, Aug. 1987 - Jul. 1988**
David K. Shuh and R. Stanley Williams 22 Jul. 1988 10 p
(Contract N00014-87-K-0014)
(AD-A198679) Avail: NTIS HC A02/MF A01 CSCL 11F

The ternary phase diagrams of the silver cadmium tellurides, indium cadmium tellurides, gold cadmium tellurides, silver mercury tellurides, indium mercury tellurides, and gold mercury tellurides systems were determined using X-ray powder diffraction and existing thermochemical data. In closed thermodynamic systems silver, indium, and gold were shown to be stable with respect to stoichiometric cadmium tellurides and silver, indium reactive towards stoichiometric mercury tellurides. The results clearly show the high chemical reactivity of metals studied with mercury tellurides is due to the high solid phase vapor pressure of the group two element, mercury, and the thermochemical stabilities of metal telluride compounds. The findings of the work support the importance of thermochemical data for the prediction of stable, metallic solid phases in ternary systems and that current contacting technology may severely limit the use of mercury tellurides in electronic devices. Author

**N89-14303*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**CASTABLE HOT CORROSION RESISTANT ALLOY Patent**
Charles A. Barrett, inventor (to NASA) and William H. Holt, inventor (to NASA) 25 Oct. 1988 6 p Continuation-in-part of US-Patent-Appl-SN-890584, filed 30 Jul. 1986
(NASA-Case-LEW-14134-2; US-Patent-4,780,276; US-Patent-Appl-SN-108331; US-Patent-Class-420-54; US-Patent-Class-420-62; US-Patent-Class-420-79; US-Patent-Class-420-80; US-Patent-Class-420-81) Avail: U.S. Patent and Trademark Office CSCL 11F

Some 10 wt percent nickel is added to an Fe-base alloy which has a ferrite microstructure to improve the high temperature castability and crack resistance while about 0.2 wt percent zirconium is added for improved high temperatur cyclic oxidation and corrosion resistance. The basic material is a high temperature FeCrAl heater alloy, and the addition provides a material suitable for burner rig nozzles.

Official Gazette of the U.S. Patent and Trademark Office

**N89-14304#** Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
**TWO-BAR THERMAL RATCHETTING OF ANNEALED 2.25Cr-1Mo STEEL**
R. W. Swindeman and D. N. Robinson (Akron Univ., OH.) 1987 8 p RPR from Thermal Stress, Material Deformation, and Thermo-Mechanical Fatigue (New York, NY, ASME), v. 123, 1987 p 91-98 Presented at the 1987 Pressure Vessels and Piping

Conference, San Diego, CA, 28 Jun. - 2 Jul. 1987; sponsored by ASME
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A02/MF A01

Annealed 2.25Cr-1Mo steel was examined under isothermal and thermal ratchetting conditions. Peak temperatures were in the range 454 to 538 C. At the lower temperatures and in the absence of long hold times cylic hardening occurred. At higher temperatures ratchetting rates in two-bar experiments were approximately constant. Recovery of the yield strength during the hold period at the peak temperature was thought to be the most significant factor controlling the ratchetting. Author

**N89-14305** Akron Univ., OH. Dept. of Civil Engineering.
**A VISCOPLASTIC CONSTITUTIVE MODEL FOR ANISOTROPIC METALS AT HIGH TEMPERATURE**
D. N. Robinson 1984 3 p RPR from Engineering Mechanics in Civil Engineering (US), v. 2, 1984 p 1025-1027 Presented at the 5th Engineering Mechanical Division Speciality Conference
Avail: Issuing Activity

The need for increased efficiency in energy systems places greater demands on the high-temperature structural alloys used for system components. As higher operating temperatures are sought, advanced materials are being developed to meet these demands. Good examples of such materials are the directionally solidified polycrystalline alloys finding application in the turbine blades of aircraft engines. The directional properties of these metals render them highly anisotropic relative to conventional alloys. This introduces additional complexity in understanding and mathematically representing their mechanical behavior over and above the already enormous complexities associated with elevated temperature. A viscoplastic constitutive model that has found application in representing behavioral features of high-temperature iostropic materials is extended to account for the effects of anisotropy. Each material point is taken to have an identifiable direction (solidification direction) designated by a vector. An extended material body is thus treated as being locally transversely isotropic, with the preferential direction generally varying from point to point as represented by a vector field. Author

# 27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

**N89-14306*#** HITCO, Gardena, CA. Materials Div.
**STATISTICAL CHARACTERIZATION OF CARBON PHENOLIC PREPREG MATERIALS, VOLUME 1 Final Report**
Don A. Beckley and John Stites, Jr. 1 Apr. 1988 209 p
(Contract NAS8-36298)
(NASA-CR-179416; NAS 1.26:179416) Avail: NTIS HC A10/MF A01 CSCL 11B

The objective was to characterize several lots of materials used for carbon/carbon and carbon/phenol product manufacture. Volume one is organized into testing categories based on raw material of product form. Each category contains a discussion of the sampling plan, comments and observations on each test method utilized, and a summary of the results obtained each category. Author

**N89-14307#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Adhesive and Sealant Science.
**DURABILITY OF ADHESIVE JOINTS: AN ENGINEERING STUDY Final Report, Jun. 1985 - Jun. 1988**
Didier R. Lefebvre, D. A. Dillard, and H. F. Brinson Jun. 1988 172 p
(Contracts N00014-82-K-0185; N00014-85-K-0145)
(PB88-233473; VPI-E-88-19; CASS/ESM-88-7) Avail: NTIS HC A08/MF A01 CSCL 11A

A methodology is proposed to relate the diffusion coefficient of water in polymers to temperature, strain and penetrant concentration. The approach used is based on well-known free volume theories. An expression for the diffusion coefficient is inferred from the temperature, strain and penetrant concentration of the free volume. It is shown that the free volume treatment can be extended to the glassy range by introducing a few additional features in the model. Experimental validation of the concentration dependence and temperature dependence of the diffusion coefficient is shown. The effect of mechanical strain on diffusivity and solubility in the glassy state is investigated experimentally. Author

**N89-14308#** Gas Research Inst., Chicago, IL.
**CERAMICS: MATERIALS FOR SEVERE ENVIRONMENTS**
1988 12 p
(PB88-240049; GRI-88/0192) Avail: NTIS HC A03/MF A01 CSCL 11C

The Gas Research Institute's (GRI) ceramic materials for research and development for industrial systems includes investigating fabrication, manufacturing, and quality control techniques, and the high temperature mechanical properties and reliability of advanced ceramics; and performance testing and evaluation. The advantage of ceramic properties in severe industrial environments led to their application in heat recovery systems, thermal sources and engine systems. The Center for Advanced Materials was established at Pennsylvania State University to provide a focal point for high temperature materials research and development. GRA

**N89-14309#** Ultrasystems Defense and Space Systems, Inc., Irvine, CA.
**BORON-NITRIDE PRECERAMIC POLYMER STUDIES**
K. J. Paciorek and R. H. Kratzer 22 Feb. 1988 21 p Presented at the 12th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, Fla., 17-20 Jan. 1988
(Contract N00014-87-C-0713)
(AD-A197359; TR-7) Avail: NTIS HC A03/MF A01 CSCL 11B

Boron nitride fibers and boron nitride coatings on alumina fibers are described. The boron nitride fibers were obtained from fusible preceramic polymer. For the coatings, a non-fusible, organic solvent soluble, preceramic polymer was utilized. Transformation of the preceramic polymers to boron nitride ceramic was accomplished in an ammonia atmosphere. The fully cured ceramics are colorless and do not undergo weight or shape changes when heated to 1000 C in nitrogen or air. GRA

**N89-14310*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**STABILITY OF BULK Ba2YCu3O(7-x) IN A VARIETY OF ENVIRONMENTS**
James R. Gaier, Aloysius F. Hepp, Henry B. Curtis, Donald A. Schupp, Paul D. Hambourger, and James W. Blue (Cleveland Clinic Foundation, OH.) Dec. 1988 13 p Presented at the Fall Meeting of the Materials Research Society, Boston, MA, 28 Nov. - 2 Dec. 1988
(NASA-TM-101401; E-4485; NAS 1.15:101401) Avail: NTIS HC A03/MF A01 CSCL 11C

Small bars of ceramic Ba2YCu3O(7-x) were fabricated and subjected to environments similar to those that might be encountered during some NASA missions. These conditions include ambient conditions, high humidity, vacuum, and high fluences of electrons and protrons. The normal state resistivity or critical current density (J sub c) were monitored during these tests to assess the stability of the material. When normal state resistivity is used as a criterion, the ambient stability of these samples was relatively good, exhibiting only a 2 percent degradation over a 3 month period. The humidity stability was shown to be very poor, and to be a steep function of temperature. Samples stored at 50 C for 40 min increased in normal state resistivity by four orders of magnitude. Kinetic analysis indicates that the degradation reaction is second order with water vapor concentration. It is suspected that humidity degradation also accounts for the ambient instability. The samples

were stable to vacuum over a period of at least 3 months. Degradation of J sub c in a 1 MeV electron fluence of 9.7 x 10 to the 14th e(-)/sq cm was determined to be no more than about 2 percent. Degradation of J sub c in a 8.7 x 10 to the 14th p(+)/sq cm of 42 MeV protons was found to be grain size dependent. Samples with smaller grain size and initial J sub c of about 240 A/sq cm showed no degradation. while that with larger grain size and an initial J sub c of about 30 A/sq cm degraded to 37 percent of its original value. Author

**N89-14311*#** State Univ. of New York, Buffalo. Dept. of Civil Engineering.
**DEVELOPMENT OF BEM FOR CERAMIC COMPOSITES Interim Status Report, Mar. - Dec. 1988**
P. K. Banerjee, G. F. Dargush, and D. P. Henry 9 Dec. 1988 76 p Prepared for Calspan-Buffalo Univ. Research Center, NY
(Grant NAG3-888)
(NASA-CR-183313; NAS 1.26:183313) Avail: NTIS HC A05/MF A01 CSCL 11C

Progress is summarized in the development of a boundary element code BEST3D, designed for the micromechanical studies of advanced ceramic composites. Additional effort was made in generalizing the implementation to allow the program to be applicable to real problems in the aerospace industry. B.G.

**N89-14312#** International Business Machines Corp., San Jose, CA. Research Lab.
**BLOCK INTERRUPT POLYSILANE DERIVATIVES**
R. D. Miller and G. N. Fickes 1 Aug. 1988 25 p Submitted for publication
(Contract N00014-85-C-0056)
(AD-A198804; TR-19) Avail: NTIS HC A03/MF A01 CSCL 07F

High molecular weight, block interrupt polysilane derivatives have been prepared by the condensation of a number of omega dichloropolysilanes with some aromatic bis silanols. In this manner, polymers containing polysilane blocks of 2, 4 or 6 catenated silicon atoms have been prepared. The materials are thermally stable and the UV spectroscopic properties mimic those of the corresponding monomers. Although these materials bleach upon irradiation in the deep UV, surprisingly, the block interrupt polysilanes behave as negative resists upon exposure to 254 nm radiation. This behavior contrasts with that of standard polysilane homopolymers which usually function in a positive lithographic mode. GRA

**N89-14313#** International Business Machines Corp., San Jose, CA. Research Center.
**RADIATION SENSITIVITY OF SOLUBLE POLYSILANE DERIVATIVES: SCIENCE AND APPLICATIONS**
R. D. Miller 1 Aug. 1988 54 p
(Contract N00014-85-C-0056)
(AD-A198805; TR-21) Avail: NTIS HC A04/MF A01 CSCL 07F

Polysilane derivatives have very unusual electronic properties associated with extensive sigma delocalization along the polymer backbone. Strong electronic transitions which depend on the nature of the substituents, the polymer molecular weight and the conformation of the backbone appear in the UV. These materials are radiation sensitive and are degraded to lower molecular weight fragments upon exposure to light and ionizing radiation. This review attempts to overview the nature of these radiation induced processes and describes some potential applications primarily in the field of microlithography. GRA

**N89-14314#** Pacific Northwest Labs., Richland, Wash.
**VIBRATION SPECTRA OF SILICA NEAR 2400 K: MEASUREMENT AND MOLECULAR DYNAMICS SIMULATION**
G. J. Exarhos, W. S. Frydrych, G. E. Walrafen, M. Fisher, E. Pugh, and S. H. Garofalini (Rutgers - The State Univ., Piscataway, N. J.) Apr. 1988 3 p Presented at the 11th International Conference on Raman Spectroscopy, London, United Kingdom, 5 Sep. 1988
(Contract DE-AC06-76RL-01830)
(DE88-015925; PNL-SA-15788; CONF-880950-2) Avail: NTIS HC A02/MF A01

The nature and distribution of localized and extended structural units in vitreous materials, which can be modified through annealing, depends upon the thermal history of the melt and the time interval over which the melt is quenched to form the glassy state. Raman spectroscopy has been used to probe chemical bonding in amorphous silica as a function of temperature, pressure, and mechanical and chemical stress, and following exposure to ionizing radiation. Results are useful in developing structural models of glass based upon molecular dynamics simulation of the vibrational spectrum of the melt. Raman spectra of vitreous silica and of melts at temperatures approaching 2400 K are reported in this work using a synchronous measurement technique which effectively minimizes the amount of blackbody radiation reaching the detector. Experimental results are compared with simulated spectra of the melt using molecular dynamics calculations based on a simple pairwise potential. A structural picture of vitreous and molten silica has been proposed based upon these comparisons. DOE

**N89-14315#** Los Alamos National Lab., NM. Materials Science and Technology Div.
**COMPOSITE FOAMS**
Alice M. Nyitray, Joel M. Williams, and Mark Wilkerson 1988 14 p Presented at the Advanced Materials Workshop, Livermore, CA, 26 Jul. 1988
(Contract W-7405-eng-36)
(DE89-000368; LA-UR-88-3019; CONF-880789-2) Avail: NTIS HC A03/MF A01

Composite foams have been prepared which incorporate the best attributes of two materials. Polystyrene emulsion foams have the advantages that they can be prepared easily over a wide range of densities (.015 g/cc to 0.20 g/cc) and are easy to handle and machine; however, the small cell sizes needed for good wicking of the DT liquid fuel are difficult to achieve. On the other hand, Si aerogel and resole foams have the desired small cell size (less than 0.1 micron), but the materials are mechanically weak making them difficult to handle and machine. Using a backfilling process, we have been able to make binary composite foams in which the cells of the polystyrene emulsion foam have been filled with aerogel or resole foam. These materials have the small cell sizes needed for good wicking of the liquid DT fuel and are rugged and easy to machine. DOE

**N89-14316#** Lawrence Livermore National Lab., CA.
**ANELASTIC AND THERMAL PROPERTIES OF ETHYLENE/ACRYLIC ACID COPOLYMERS PARTIALLY IONIZED WITH TRANSITION METALS**
D. Mark Hoffman, Florida M. Matthews, Michael O. Riley, and Connie M. Walkup 1988 25 p Presented at the 196th American Chemical Society National Meeting, Los Angeles, CA, 25 Sep. 1988
(Contract W-7405-eng-48)
(DE88-017006; UCRL-98479; CONF-880912-14) Avail: NTIS HC A03/MF A01

Ionomers of five 3d series transition metals (Mn, Fe, Co, Ni, and Cu), two Lanthanide series transition metals (Ce, Sm) and the IV and V series metals (Pb, Bi) were prepared by reaction with 25 percent solids dispersion of poly (ethylene-co-acrylic acid), EAA, in aqueous ammonia. The unreacted copolymer showed two mechanical relaxations, the glass transition at about 5C and a low temperature secondary relaxation at about -140 C with 230 + or - 10 kJ/mol and 50 + or - 8 kJ/mol apparent activation energies, respectively. Typically three weight percent of the metal nitrate or acetate was reacted with the copolymer dispersion. After precipitation, drying and molding, the ionomers showed three mechanical relaxations. The low temperature gamma-relaxation was quite strong and shifted about 5 C higher compared to the EAA copolymer. The beta-relaxation was extremely weak occurring at -62 + or - 5 C in the loss tangent at 1.0 Hz. The alpha-relaxation or glass transition for 3 percent transition metal ionomers occurred at about 26 + or - 3 C for +3 oxidation states and Cu(2+) but

significantly higher for other +2 oxidation states (48 + or - 2 C for Co, Ni and 35 C for Mn) based on G double prime maxima at 1.0 Hz and the apparent activation energy was 220 + or - 30 kJ/mol. The two group IV and V metal ionomers were much higher loadings and had a much broader and stronger (beta prime) relaxation occurring at -6 + or - 4C with 130 + or - 10 kJ/mol activation energies. The lead ionomers were clear but the bismuth ionomer showed macroscopic phase separation. The 3d transition metal ionomers were clear and nicely colored characteristic of their ionization state except for iron which was somewhat cloudy. The Lanthanide ionomers were clear (Ce) or pale yellow (Sm) and also reasonably transparent. DOE

**N89-14317#** Lawrence Livermore National Lab., CA.
**A SYNTHETIC ROUTE TO ORGANIC AEROGELS: MECHANISM, STRUCTURE, AND PROPERTIES**
R. W. Pekala and Fung-Ming Kong 1988 22 p Presented at the 2d International Symposium on Aerogels, Montpellier, France, 21 Sep. 1988
(Contract W-7405-eng-48)
(DE88-017112; UCRL-99554; CONF-8809131-1) Avail: NTIS HC A03/MF A01

The base catalyzed, aqueous reaction of resorcinol with formaldehyde follows a sol-gel pathway in which surface functionalized polymer clusters are formed. The covalent crosslinking of these clusters produces gels which are dried under supercritical conditions to obtain low density, organic aerogels organic aerosols (less than or equal 200 mg/cc). The aerosols are transparent and have cell sizes less than 1000 A. Their microstructure consists of interconnected colloidal-like particles with diameters of 30 to 100 A. The particle size, cell size, surface area, and density of resorcinol-formaldehyde (RF) aerogels are largely determined by the catalyst concentration in the mixture. RF aerogels are similar to silica aerogels in many ways, yet a comparison of their mechanical properties suggests subtle morphological differences. DOE

**N89-14318#** Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Chemistry.
**RHEOLOGICAL AND RHEO-OPTICAL STUDIES WITH NEMATOGENIC SOLUTIONS OF A RODLIKE POLYMER: A REVIEW OF DATA ON POLY(PHENYLENE BENZOBISTHIAZOLE)**
G. C. Berry 1987 31 p
(Contract F49620-85-C-1040)
(AD-A197994; AFOSR-88-0816TR) Avail: NTIS HC A03/MF A01 CSCL 07F

Rheological and rheo-optical studies on isotropic and nematic solutions of poly(1,4-phenylene-2, 6-benzobisthiazole), PBT, are reviewed. The linear viscoelastic behavior is compared with theoretical models for the isotropic data; comparisons with theoretical models are made. With the nematic solutions, nonlinear viscoelastic behavior is found even for very slow shearing deformations. This behavior may be related to orientation effects at the bounding surfaces. For more rapid shearing deformations, the bulk of the fluid is strongly oriented, similar to the orientation obtained in the isotropic fluid at high rates of shearing deformation. Comparisons are made among a number of rheological properties for isotropic and nematic solutions for the latter flows. GRA

**N89-14319#** Naval Research Lab., Washington, DC.
**THE EFFECT OF HIGH HEATING RATE ON THE PYROLYSIS OF POLYMERIC AND COMPOSITE MATERIALS**
M. E. Boyle, R. F. Cozzens, and J. A. McPherson 1988 25 p
(AD-A198052) Avail: NTIS HC A03/MF A01 CSCL 11D

The pyrolysis of a carbon/phenolic sample has been investigated as a function of heating rate (from 0.167 K/sec to 30000 K/sec) and has been modeled by assuming two mechanisms are operating: a process with a low energy of activation which dominates at low heating rates and a process with a high energy of activation which becomes important at high heating rates. Kinetic and modeling parameters for sample pyrolysis at each heating rate are reported and have been used to accurately reconstruct the sample thermographs. In addition, the high heating rate instrument/method is described in detail. In this work, we report on the effect of bulk heating rates (ranging from 0.167 K/min to 30000 K/sec) on the pyrolysis of a carbon/phenolic composite material. GRA

**N89-14320#** Arizona State Univ., Tempe.
**EVALUATION OF MICROWAVE ANECHOIC CHAMBER ABSORBING MATERIALS M.S. Thesis**
Stephen A. Brumley May 1988 207 p Sponsored in part by Hughes Aircraft Co. and Motorola, Inc.
(AD-A198055) Avail: NTIS HC A10/MF A01 CSCL 20I

This thesis discusses an anechoic chamber absorber evaluation which was conducted for the purpose of improving anechoic chamber and compact range performance through better absorber characterization. The need for a better understanding of anechoic absorbers is first illustrated by a review of past work in this area and a discussion of present chamber requirements. The approach taken to obtain this improved characterization of absorbers was to experimentally investigate the scattering nature of various types and sizes of materials. This study shows that performance of conventional absorber materials is dependent on selection of the material's shape, size and orientation with respect to the incident energy direction, and that performance is also altered by the use of fire retarding chemicals used in the absorber. Nonhomogeneities in the material composition and physical structure were also found to significantly modify performance, in some cases even improving it. GRA

**N89-14321#** Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
**CONDENSATION POLYMERS WITH CONTROLLED STRUCTURE**
W. R. Meyer, F. T. Gentile, and U. W. Suter 13 Jul. 1988 13 p
(Contract N00014-85-K-0161)
(AD-A198086) Avail: NTIS HC A03/MF A01 CSCL 07F

Wholly aromatic amides (aramides) represent a class of polymers of exceptional technological importance. Fibers with high mechanical strength and thermal resistance, obtained from nematic solutions of these polymers, are at present employed in a variety of industrial applications requiring extraordinary performances. As stated in our last report, this project's objective is to investigate the effects of constitutional isomerism in aramides arising when non-symmetric substituents are introduced into the main chain. We tried to solve the problem of determination of the polymers' structural regularity in two independent ways. On one hand, we calculated expected values for the order parameters for all the compounds we synthesized applying the theory constitutional isomerism. On the other hand we tried to determine the structural order of our polymers directly through nuclear magnetic resonance. GRA

**N89-14322#** University of Southern Mississippi, Hattiesburg. Dept. of Polymer Science.
**VARIABLE TEMPERATURE SOLID STATE NMR OF SIDE-CHAIN CRYSTALLINE COMB POLYMERS Technical Report No. 12, 15 Jul. - 3 Aug. 1988**
Lon J. Mathias 3 Aug. 1988 12 p
(Contract N00014-86-K-0659)
(AD-A198099) Avail: NTIS HC A03/MF A01 CSCL 07F

Polymers with side-chain groups capable of crystallization independent of the backbone have been of interest for many years. Recent reviews summarize the syntheses and characterization of a large number of different families of comb polymers. The easiest to synthesize and evaluate with respect to property trends in a homologous series are those containing linear alkyl side-chains. Derivatives with greater than 8 to 12 carbons form side-chain crystals with hexagonal packing of the alkyl moieties. In this type of packing, individual alkyl groups adopt an all-trans conformation but with rotational disorder between side-chains. In the process of characterizing the various DHA polymers synthesized, we became interested in the use of solid state C nuclear magnetic

resonance (NMR) to evaluate several thermal transitions that we have tentatively ascribed to separate side-chain and backbone molecular relaxation processes. GRA

**N89-14323#** North Texas State Univ., Denton. Dept. of Chemistry.
**SYNTHESIS OF NEW POLYNITROPOLYHEDRANES Final Technical Report, 1 Apr. 1984 - 31 Mar. 1988**
Alan P. Marchand 8 Jul. 1988 36 p
(Grant AF-AFOSR-0085-84; AF Proj. 2303)
(AD-A198320; AFOSR-88-0915TR) Avail: NTIS HC A03/MF A01 CSCL 07C

A significant portion of our overall research program has been concerned with the synthesis and chemistry of novel, strained polycyclic cage hydrocarbon systems. The objective of our AFOSR-sponsored research program is to extend our earlier interests in the pentacyclo 5.4.0.02,6.03,10.05,9 undecane (PCUD) and pentacyclo 5.4.0.02,5,03,9.04,8 decane (1,3-bishomocubane) ring systems to include the syntheses of new polynitro derivatives of these molecules. We seek new ways to incorporate increasing numbers of NO2 groups into novel cage molecules with the ultimate goal of synthesizing a fully penitrated cage molecule, Cn(NO2)m. Our approach to these syntheses involves introducing increasing numbers of NO2 groups into a given cage system by employing a logical progression of increasingly functionalized synthetic intermediates. Thus, we are able to gauge the cumulative effects of increasing substitution (particularly NO2 substitution) upon product stability and upon the relative ease of product-forming reactions in a gradual and orderly fashion. Importantly, such approaches represent entirely new synthetic methodology for incorporating large numbers of NO2 substituents into novel, strained systems. GRA

**N89-14324#** Southwest Research Inst., San Antonio, Tex. Dept. of Materials Sciences.
**STUDY OF HIGH TEMPERATURE FAILURE MECHANISMS IN CERAMICS Final Report, 1 Apr. 1985 - 31 Mar. 1988**
Richard A. Page and James Lankford Jun. 1988 68 p,
(Contract F49620-85-C-0073)
(AD-A198375; SWRI-8578/5; AFOSR-88-0804TR) Avail: NTIS HC A04/MF A01 CSCL 11B

This report summarizes the results of a fundamental study involving experimental characterization and analytical modeling of grain boundary cavitation and creep crack growth in structural ceramics exposed to pure tensile loading. The major experimental techniques employed in the program are the use of small-angle neutron scattering to characterize cavity nucleation and growth and stereoimaging analysis to characterize the stress and strain fields associated with growing creep cracks. The major accomplishments described in the report include the design, construction, and successful testing of a creep apparatus that permits creep testing of ceramics under pure tensile loading, the determination of surface preparation conditions that are adequate for the stereoimaging analysis, and the conduct of a series of creep tests designed to characterize the kinetics of damage accumulation under pure tensile loading. GRA

**N89-14325#** Naval Surface Weapons Center, Silver Spring, MD.
**SYNTHESIS OF ENERGETIC SINGLE PHASE AND MULTI-PHASE POLYMERS Annual Progress Report, 1 Jan. - 31 Dec. 1987**
H. G. Adolph, J. M. Goldwasser, D. A. Cichra, L. A. Nock, and M. Chaykovsky 31 Mar. 1988 58 p
(AD-A198431) Avail: NTIS HC A04/MF A01 CSCL 07F

Investigation of the synthesis of polyformals from fluoro- and nitrodiols was continued at a low level. The synthesis of 3,5,5,11,11,13 hexanitro 3,13 diaza 7,9 dioxapentadecane 1,15 diol polyformal, a high energy nitro polymer for use in cast-curable binders, was completed. A new fluoropolyformal was prepared from 3M fluoropolyether diol L-9939. One pound of eptane-1,7-diol polyformal was prepared for evaluation in pyrotechnic formulations. A series of copolyformals was prepared from nitrodiols and fluorodiols with the objective to obtain energetic prepolymers with low T sub G useful as cast-curable binder and as energetic soft blocks for thermoplastic-elastomeric (TPE) block copolymers. Several of the new polymers appear to meet this goal, based on qualitative observation of their properties. A copolymer of 2,2,3,3,4,4,5,5 octafluorohexane 1,6 diol and 3-nitrazapentane-1,5-diol may be useful as a replacement for hexafluoropentanediol polyformal (FPF-1) in cast-curable binder applications. A second copolymer in bis (hydroxyethyl) orthocarborane, with octafluorohexanediol, was prepared. The synthesis of a series of acid chloride-terminated polyesters from fluoro- and nitrodiols and 4,4-dinitropimeloyl chloride and malonyl chloride, respectively, and their reaction with monomeric and polymeric diols to form (AB)N block copolymer was investigated. GRA

**N89-14326#** Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Chemistry.
**RHEOLOGICAL STUDIES ON BLENDS OF RODLIKE AND FLEXIBLE CHAIN POLYMERS**
G. Kim, V. Sullivan, and G. C. Berry 1988 5 p Repr. from ANTEC (US), 1988 p 990-993
(Contract F49620-85-C-0140; AF Proj. 2303)
(AD-A198455; AFOSR-88-0889TR) Avail: NTIS HC A02/MF A01 CSCL 20D

Rheological studies are reported on blends or rodlike and flexible chain polymers in solution. All data are for composition for which the components are fully miscible. A principal effect is a substantial enhancement that may occur in the viscosity n sub 0 at low shear rate. The reduced distribution of relaxation times normalized for the change in rheology is relatively independent of the concentration of the flexible chain polymer. The data are discussed in the context of a single-integral constitutive relation of the BZK type. GRA

**N89-14327#** Honeywell, Inc., New Hope, MN. Ceramics Center.
**MECHANICAL RELIABILITY OF PIEZOELECTRIC AND DIELECTRIC CERAMICS Final Technical Report, 1 Jun. 1983 - 1 Jun. 1987**
K. D. McHenry and B. G. Koepke 1 Jun. 1988 78 p
(Contract N00014-83-C-0141)
(AD-A198458) Avail: NTIS HC A05/MF A01 CSCL 11B

Mechanical Reliability of various piezoelectric and dielectric ceramic materials has been investigated with respect to material anisotropy and operational environments. A variety of fracture mechanics testing techniques have been employed to characterize subcritical crack growth in multilayer PZT and multilayer Z5U capacitors. Subcritical crack growth is extremely sensitive to environment (chemical and electrical) as well as geometrical anisotropy of the multilayer structures. GRA

**N89-14328#** North Texas State Univ., Denton. Dept. of Chemistry.
**POLYSILYLATED UNSATURATED MOLECULES Final Report, 1 Sep. 1983 - 29 Feb. 1988**
Paul R. Jones 15 Jul. 1988 12 p
(Grant AF-AFOSR-0244-83; AF Proj. 2303)
(AD-A198492; AFOSR-88-0750TR) Avail: NTIS HC A03/MF A01 CSCL 07C

A series of functionalized disilyl-substituted acetylenes, cyclic and linear polysilyl polyacetylenes and cyclic polysil oxypolyacetylenes were synthesized and characterized. The disilylacetylenes served as precursors to disilylated benzenes which were isomerized to their thermodynamically most stable meta isomers using molecular iodine as the catalyst. The studies on the oligomeric polysilyl polyacetylenes and the polysil oxypolyacetylenes included: (1) the determination of their spectral and non-linear optical properties, (2) photochemical polymerization, (3) formation of complexes with transition metal carbonyls, and (4) studies of nucleophilic cleavage reactions aimed at determining suitable reagents and conditions for potential ring-opening polymerization reactions. GRA

**N89-14329#** Pennsylvania State Univ., University Park. Dept. of Chemistry.
**THE SYNTHESIS AND STRUCTURE OF POLYPHOSPHAZENES Final Report, 15 Apr. 1985 - 14 Apr. 1988**
Harry R. Allcock 13 Jun. 1988 6 p
(Contract DAAG29-85-K-0111)
(AD-A198519; ARO-22614.13-CH) Avail: NTIS HC A02/MF A01 CSCL 07F

The synthesis and evaluation of new polymers derived from the inorganic elements are described. Specifically, the goal was to develop new methods of synthesis for polyphosphazenes and to develop an understanding of the ways in which changes in molecular structure alter the properties of the polymers and allow improved polymers to be designed. First, a method has been developed for the synthesis of new polyphosphazenes with cyano side groups, and these have been used as precursors for the construction of organic side groups derived from the phosphazene-nitrile structure. The new polymers are expected to be useful as new films and elastomers. Second, a number of new classes of cyclo- and polyphosphazenes have been prepared incorporating transition metals, such as iron, ruthenium, chromium, or cobalt into the organometallic side group structure. These macromolecules are hybrid polymer-metal materials, some of which combine the properties of organic polymers with those of metals. Typical of these materials are polyphosphazenes with ferrocene units as side groups. These show semiconductor properties and unusual oxidation-reduction behavior. Third, a series of small molecule linear phosphazenes have been prepared that serve as synthetic and structural models for the high polymers. GRA

**N89-14330#** Aerojet Solid Propulsion Co., Sacramento, CA.
**THE SYNTHESIS OF CARBORANE-OXETANE MONOMERS AND THEIR POLYMERIZATION Quarterly Progress Report, No. 6, 1 Apr. - 30 Jun. 1988**
G. E. Manser 11 Jul. 1988 14 p
(Contract N00014-86-C-0164)
(AD-A198596) Avail: NTIS HC A03/MF A01 CSCL 07C

Modern rocket propellants, gun propellants, and explosives are an adaptation of the basic concept of a formulation consisting of a solid oxidizer and fuel held in a polymeric matrix. In 1978, a research effort was undertaken to synthesize energetic polymeric binders specifically designed for propellant applications. A modified cationic polymerization technique was developed, which allowed the synthesis of polymers to predetermined molecular weight and functionality, and the concept of energetic polyoxetanes was presented. Further work has now resulted in nitrate ester, nitramine polymers, copolymers, and recently nitro, cubane and carborane polymers. The latter is the subject of this paper. Boron or boron compounds have been used as a burning rate modifier and as a metal fuel source in solid propellant motors. Migration of these chemicals in the propellant grain is a continuous and serious problem. It is proposed that a urethane curable polyether glycol with a carboranyl functionality would solve migration problems. Oxetane-carboranes would be good candidates as monomers for these carboranyl pendant polymers. These monomers could be homopolymerized or co-polymerized with other oxetanes for specific properties. This paper describes the synthesis, characterization, and polymerization of oxetane-carborane monomers. GRA

**N89-14331*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**ATOMIC OXYGEN EFFECTS MEASUREMENTS FOR SHUTTLE MISSIONS STS-8 AND 41-G**
James T. Visentine, comp. Sep. 1988 94 p
(NASA-TM-100459-Vol-1; NAS 1.15:100459-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 07D

The effects of atomic oxygen exposure upon typical spacecraft materials, such as polyimide films, thermal control paints, epoxies, silicones, and fluorocarbons are summarized. B.G.

**N89-14332*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**ATOMIC OXYGEN EFFECTS MEASUREMENTS FOR SHUTTLE MISSIONS STS-8 AND 41-G**
James T. Visentine, comp. Sep. 1988 90 p
(NASA-TM-100459-Vol-2; NAS 1.15:100459-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 07D

The effects of the atomic oxygen interactions upon optical coatings, thin metallized films, and advanced spacecraft materials, such as high temperature coatings for infrared optical systems are summarized. Also included is a description of a generic model proposed by JPL, which may explain the atomic oxygen interaction mechanisms that lead to surface recession and weight loss. B.G.

**N89-14333#** Limoges Univ. (France). Equipe Thermodynamique.
**MULTILAYER PLASMA COATS USED AS THERMAL BARRIER IN ENGINES Final Report, 1985-1986 [DEPOTS PLASMA MULTICOUCHES UTILISES COMME BARRIERE THERMIQUE DANS LES MOTEURS]**
22 Sep. 1987 325 p In FRENCH
(Contract DRET-84-34-00-201-470-75-01)
(ETN-89-93598) Avail: NTIS HC A14/MF A01

Plasma gun coating parameters were studied including plasma temperature and trajectory, particle temperature and velocity, cooling conditions of the ceramic deposits, thermal resistance of deposits and shock resistance of the plasma coated surfaces. The ultimate goal is the extension of gas turbine temperature range to 1400 C. The results obtained under reduced pressure lead to concentration of zircon projections (stabilized with 7 percent Y203). A procedure to study thermal shock using infrared thermography was developed. Plasma temperature control is found important to obtain thick deposits. ESA

**N89-14334#** Societe Nationale des Poudres et Explosifs, Vert-Le-Petit (France).
**CHARACTERIZATION STUDY OF THE STRUCTURAL BONDING SYSTEM EA 9680 (EA 9645). TEST REPORT 1/R/86 [ETUDE DE CARACTERISATION DU SYSTEME DE COLLAGE STRUCTURAL EA 9680. PROCES-VERBAL 1/R/86]**
5 May 1986 14 p In FRENCH
(Contract STPA-84-96501-00)
(Rept-1/R/86; ETN-89-93603) Avail: NTIS HC A03/MF A01

The adhesive film HYSOL EA 9680 was applied over the anticorrosion prime EA 9205 applied after anodic/chromic oxidation on 2024T3 aluminum alloy plates. The bonded joints cured either at 120 or 175 C have a shear resistance of 30 MPa and 6.7 MPa in perpendicular traction. The conservation of properties after humid aging is excellent. ESA

**N89-14335#** Aerospatiale, Suresnes (France). Direction de la Qualite.
**METAL-METAL BONDING: CONTRIBUTION TO THE STUDY OF AGING. TEST REPORT 48-453/F [COLLAGE METAL/METAL: CONTRIBUTION A L'ETUDE DU VIEILLISSEMENT. PROCES-VERBAL 48-453/F]**
J. Odorico and J. N. Dewas 27 Sep. 1988 22 p In FRENCH
(Contract STPA-85-96-032-00-471-75-86)
(Rept-48-453/F; ETN-89-93604) Avail: NTIS HC A03/MF A01

The residual mechanical characteristics of bonded joints of given geometry specimens, at the initial state and after aging, wet or dry, with static, dynamic, or null loads are studied. The adhesive system used is designated as FM61 + BR227. The metals are 7075 and 2024 aluminum alloys. No loss of mechanical properties is observed. ESA

**N89-14336#** Aerospatiale, Suresnes (France). Direction Centrale de la Qualite.
**INFLUENCE OF THE APPLICATION PARAMETERS OF PRIMER COATS FOR BONDING. TEST REPORT 49-064/F [INFLUENCE DES PARAMETRES D'APPLICATION DES PRIMAIRES DE COLLAGE. PROCES-VERBAL 49-064/F]**

D. Corman and D. Bouvart 3 Aug. 1988 32 p In FRENCH (Contract STPA-86-96-015)
(Rept-49-064/F; ETN-89-93605) Avail: NTIS HC A03/MF A01

Primer application parameters were studied in order to obtain an optimum deposition of anticorrosion coatings using an oleopneumatic robot. The parameters include the distance gun/object, the displacement velocity, the number of passes, and the drying conditions. The thickness of the layers varies from 1 to 6 microns for each pass depending strongly on the parameter values. The variations are the same as those observed in manual applications. A greater arm rigidity is recommended. ESA

**N89-14337*** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**POLYPHENYLQUINOXALINES CONTAINING ALKYLENEDIOXY GROUPS Patent**
Paul M. Hergenrother, inventor (to NASA), Stephen J. Havens, inventor (to NASA), and Frank W. Harris, inventor (to NASA) (Akron Univ., OH.) 29 Nov. 1988 8 p Filed 23 Mar. 1987 Supersedes N87-25475 (25 - 19, p 2598)
(NASA-Case-LAR-13601-1-CU; US-Patent-4,788,271; US-Patent-Appl-SN-028831; US-Patent-Class-528-125; US-Patent-Class-528-128) Avail: U.S. Patent and Trademark Office CSCL 11B

Polyphenylquinoxalines were prepared from the reaction of bis(alpha-diketones) with aromatic bis(ortho-diamines). These polyphenylquinoxalines have lower glass transition temperatures and melt viscosities and consequently better processability than known polyphenylquinoxalines. The properties of these polyphenylquinoxalines (tensile strength, modulus, elongation, adhesive strength, fracture energy, and solvent resistance) are comparable with the properties of known polyphenylquinoxalines. Official Gazette of the U.S. Patent and Trademark Office

**N89-14338*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**SOME COMPOSITE BEARING AND SEAL MATERIALS FOR GAS TURBINE APPLICATIONS: A REVIEW**
Harold E. Sliney [1989] 15 p Prepared for presentation at the 34th International Gas Trubine and Aeroengine Congress and Exposition, Toronto, Ontario, 4-8 Jun. 1989; sponsored by ASME (NASA-TM-101451; E-4561; NAS 1.15:101451) Avail: NTIS HC A03/MF A01 CSCL 11A

A review is made of the selection and tribological testing of materials for high-temperature bearings and seals. The goal is to achieve good tribological properties over a wide range of temperatures because bearings and seals must be functional from low temperature start-up conditions on up to the maximum temperatures encountered during engine operation. Plasma sprayed composite coatings with favorable tribological properties from 25 to 900 C are discussed. The performance of these coatings in simple tribological bench tests is described. Examples are also given of their performance in high-speed sliding contact seals and as Stirling cylinder liner materials, and as back up lubricants for compliant foil gas bearings. Author

**N89-14910*#** Bethune-Cookman Coll., Daytona Beach, FL. Div. of Science and Mathematics.
**COMPUTER MODELING OF POLYMERS Abstract Only**
Terry J. Green *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 65-66 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11C

**N89-14912*#** Tennessee Univ., Knoxville. Dept. of Chemical Engineering.
**SEMI-INTERPENETRATING POLYMER NETWORK'S OF POLYIMIDES: FRACTURE TOUGHNESS Abstract Only**
Marion Glenn Hansen *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 70 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11C

**N89-14914*#** College of William and Mary, Williamsburg, VA. Dept. of Chemistry.
**RADIATION EFFECTS ON POLYMERIC MATERIALS Abstract Only**
Richard L. Kiefer *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 72-74 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11C

**N89-14921*#** College of William and Mary, Williamsburg, VA. Dept. of Chemistry.
**THE EFFECTS OF ATOMIC OXYGEN ON POLYMERIC MATERIALS Abstract Only**
Robert A. Orwoll *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 88-89 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11C

**N89-14926*#** Akron Univ., OH. Dept. of Polymer Engineering.
**POLYMER POWDER PREPREGGING: SCOPING STUDY Abstract Only**
James L. Throne *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 99-100 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11C

# 28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

**N89-14339#** Ballistic Research Labs., Aberdeen Proving Ground, MD.
**A PRELIMINARY REPORT ON DEVELOPING AN EXPERT SYSTEM FOR COMPUTER-AIDED FORMULATION OF PROPELLANTS Final Report, Jan. - Sep. 1987**
Frederick J. Shaw and Robert A. Fifer Mar. 1988 29 p
(AD-A198088; BRL-TR-2895) Avail: NTIS HC A03/MF A01 CSCL 12E

An expert system is being developed which will automate the propellant formulation design process. The expert system uses Insight 2+, an expert system shell operating on an IBM AT-compatible microcomputer. The user is asked to specify requirements (e.g., desired energy, cost, burn rate, specific ingredient preferences) for the basic ingredients (oxidizer, binder, plasticizer,...). Based on these requirements, the individual ingredient databases are screened and those ingredients consistent with the criteria are saved to datafiles. Propellant formulations are then generated from the different possible combinations of ingredients in the datafiles with rule-based criteria being used to exclude incompatible combinations, etc. Additional modules are being developed which will use rules, simple relationships (equations), or accessible computer programs to predict the properties (cost, sensitivity, mechanical behavior, etc.) of the formulations so generated, and interactively help the user select one or more of the formulations for a specific application. GRA

**N89-14340#** Army Armament Research, Development and Engineering Center, Watervliet, NY. Close Combat Armaments Center.
**DISCUSSION AND EXPLANATION OF UNPLANNED IGNITION INCIDENT: IGNITION CAUSED BY RAPID PRESSURIZATION OF A PROPELLANT CONTAINING BUBBLES Final Report**

Julius Frankel Jul. 1988 18 p
(DA Proj. 1A8-DZ8-AANMTS)
(AD-A198419; ARCCB-TR-88029) Avail: NTIS HC A03/MF A01 CSCL 19A

Propellants, even though they may have extremely safe handling characteristics in a vast majority of circumstances, still have to be utilized so that certain ranges of specific outside parameters are excluded during or prior to the intended detonation. The understanding and prevention of such exceptions to safe predictable use is the subject of intense interest to anyone responsible for utilization and transportation of these materials. The latest unplanned incident involving LP (liquid propellant) 1846 has been the subject of a Red Team study and report which is summarized in the Appendix. Outlined in the present report are the reasons why first consideration should be given to adiabatic compression of gas bubbles as the most likely source of the unplanned ignition due to rapid pressurization. Also included is a discussion of this topic from a thermodynamic viewpoint, as an explanation of the recent unplanned incident, and some of the extensive Army literature on this topic. GRA

# 29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology*.

**N89-14341*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**EFFECTS OF CRUCIBLE WETTING DURING SOLIDIFICATION OF IMMISCIBLE Pb-Zn**
Henry C. deGroh, III and Hubert B. Probst Dec. 1988 8 p Presented at the 27th Aerospace Sciences Meeting, Reno, NV, 9-12 Jan. 1989
(NASA-TM-101372; E-4419; NAS 1.15:101372) Avail: NTIS HC A02/MF A01 CSCL 22A

Many industrial uses for liquid phase miscibility gap alloys are proposed. However, the commercial production of these alloys into useful ingots with a reasonable amount of homogeneity is arduous because of their immiscibility in the liquid state. In the low-g environment of space gravitational settling forces are abated, thus solidification of an immiscible alloys with a uniform distribution of phases becomes feasible. Elimination of gravitational settling and coalescence processes in low-g also makes possible the study of other separation and coarsening mechanisms. Even with gravitational separation forces reduced, many low-g experiments have resulted in severely segregated structures. The segregation in many cases was due to preferential wetting of the crucible by one of the immiscible liquids. The objective was to analyze the wetting behavior of Pb-Zn alloys on various crucible materials in an effort to identify a crucible in which the fluid flow induced by preferential wetting is minimized. It is proposed that by choosing the crucible for a particular alloy so that the difference in surface energy between the solid and two liqud phases is minimized, the effects of preferential wetting can be diminished and possibly avoided. Qualitative experiments were conducted and have shown the competitive wetting behavior of the immiscible Pb-Zn system and 13 different crucible materials. Author

**N89-15006*#** California Inst. of Tech., Pasadena. Seismological Lab.
**PROPOSED EARTH-BASED CRATERING EXPERIMENTS AT LOW g IN HARD VACUUM Abstract Only**
Thomas J. Ahrens *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p Previously announced as N86-27142 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15008*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**IMPACT CRATERING IN REDUCED-GRAVITY ENVIRONMENTS: EARLY EXPERIMENTS ON THE NASA KC-135 AIRCRAFT**
Mark J. Cintala, F. Hoerz, and T. H. See (Lockheed Engineering and Management Services Co., Inc., Houston, TX.) *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15009*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**LOW-GRAVITY IMPACT EXPERIMENTS: PROGRESS TOWARD A FACILITY DEFINITION**
Mark J. Cintala *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15016*#** Department of Energy, Mines, and Resources, Ottawa (Ontario). Earth Physics Branch.
**IMPACT EXPERIMENTATION AND THE MICROGRAVITY ENVIRONMENT: AN OVERVIEW**
Richard A. F. Grieve *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15020*#** Iowa State Univ. of Science and Technology, Ames. Dept. of Aerospace Engineering.
**SEDIMENT-TRANSPORT EXPERIMENTS IN ZERO-GRAVITY**
James D. Iversen and Ronald Greeley (Arizona State Univ., Tempe.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p Previously announced as N86-27153 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15023*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**DYNAMIC CRYSTALLIZATION EXPERIMENTS ON CHONDRULE MELTS IN REDUCED GRAVITY**
Gary Lofgren and R. J. Williams *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15026*#** Arizona State Univ., Tempe. Dept. of Geology.
**CAUTIONARY TALES FOR REDUCED-GRAVITY PARTICLE RESEARCH**
John R. Marshall, Ronald Greeley, and D. W. Tucker *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15030*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**NUCLEATION AND PARTICLE COAGULATION EXPERIMENTS IN MICROGRAVITY**
J. Nuth *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15032*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**LOW-GRAVITY FACILITIES FOR SPACE STATION PLANETOLOGY EXPERIMENTS**
Paul A. Penzo *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space

Station Nov. 1987 2 p Previously announced as N86-27160 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15037*#** Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Geology.
**TEXTURAL EVOLUTION OF PARTIALLY-MOLTEN PLANETARY MATERIALS IN MICROGRAVITY**
E. B. Watson *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15038*#** California Inst. of Tech., Pasadena. Div. of Physics, Mathematics, and Astronomy.
**GRAIN DYNAMICS IN ZERO GRAVITY**
B. T. Werner and P. K. Haff *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15040*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**A SYSTEM FOR CONDUCTING IGNEOUS PETROLOGY EXPERIMENTS UNDER CONTROLLED REDOX CONDITIONS IN REDUCED GRAVITY**
Richard J. Williams *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p Previously announced as N86-27166 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

**N89-15045*#** Arizona Univ., Tucson. Dept. of Planetary Sciences.
**CONTAINERLESS HIGH-PRESSURE PETROLOGY EXPERIMENTS IN THE MICROGRAVITY ENVIRONMENT OF THE SPACE STATION Abstract Only**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

# 31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

**N89-14342*#** Massachusetts Inst. of Tech., Cambridge. Lincoln Lab.
**SOLID STATE RESEARCH Quarterly Technical Report, 1 Aug. - 31 Oct. 1987**
Alan L. McWhorter 11 Mar. 1988 74 p Sponsored in part by NASA, Army, DARPA, Navy, SDIO, and DOE
(Contract F19628-85-C-0002; AF Proj. 649L)
(NASA-CR-183328; NAS 1.26:183328; AD-A194708; ESD-TR-87-251; Rept-1987-4) Avail: NTIS HC A04/MF A01 CSCL 13B

This report covers in detail the solid state research work of the Solid State Division at Lincoln Laboratory for the period 1 August through 31 October 1987. The topics covered are Solid State Device Research, Quantum Electronics, Materials Research, Microelectronics, and Analog Device Technology. Funding was provided primarily by the Air Force, with added support from Army, DARPA, Navy, SDIO, NASA, and DOE. For individual titles, see N89-14343 through N89-14347.

**N89-14343*#** Massachusetts Inst. of Tech., Cambridge.
**MONOLITHIC TWO-DIMENSIONAL SURFACE-EMITTING ARRAYS OF GaAs/AlGaAs DIODE LASERS c76**
*In its* Solid State Research 11 Mar. 1988 p 1-11 (For primary document see N89-14342 06-31)
Avail: NTIS HC A04/MF A01 CSCL 13B

Monolithic two-dimensional arrays of GaAs/AlGaAs diode lasers with light emission normal to the surface have been obtained by fabricating edge-emitting quantum-well lasers coupled with external mirrors that deflect the radiation from the laser facets by 90 degrees. Linear arrays of GaAs/AlGaAs devices in which one of the laser facets was cleaved while the other facet and an adjacent 45 degree deflector were formed by ion-beam-assisted etching (IBAE) have been reported. For the arrays reported in this section, IBAE was used to form all of the laser facets and the deflecting mirrors. A mass transport process of the type employed to fabricate two-dimensional arrays of GaInAsP/InP lasers coupled with deflecting mirrors is not known for AlGaAs. Author

**N89-14344*#** Massachusetts Inst. of Tech., Cambridge.
**SYNCHRONOUSLY PUMPED MODE-LOCKED Ti:Al2O3 LASERS c33**
*In its* Solid State Research 11 Mar. 1988 p 13-22 (For primary document see N89-14342 06-31)
Avail: NTIS HC A04/MF A01 CSCL 13B

Synchronously pumped mode-locked laser operation in a Ti:Al2O3 ring laser is demonstrated. The laser pump source was a frequency-doubled Nd:YAG laser-amplifier system producing a 60-micron-long macropulse that comprised a wavetrain of mode-locked 70-ps micropulses with a 10-ns spacing (100 MHz). The Ti:Al2O3 laser consisted of a 1-cm-long crystal with faces cut at the Brewster angle and placed in a ring laser cavity configuration with a 2 percent output coupling mirror. The cavity was adjusted for a 5-ns round trip transit time, which was close to half the temporal spacing of the pump pulse. When the crystal was pumped synchronously at 532 nm with a 30-mJ macropulse, which was approximately an order of magnitude above the laser threshold, mode-locked lasing at approximately 200 MHz was obtained. This macropulse pump energy corresponds to an average micropulse pump energy of about 5 microJ at the Ti:Al2O3 crystal face. The mode-locked operation of the Ti:Al2O3 was observed only after several microseconds into the macropulse, indicating a long build-up process over many cavity trips. During this time, relaxation oscillations were observed. When mode locking started, the relaxation oscillation frequency increased by an order of magnitude. Synchronous pumping has been limited to operation with dye lasers and used either a CW or pulsed mode-locked pump source. Recent work has demonstrated CW mode-locked operation of a Ti:Al2O3 laser. The result raises the possibility that pulsed synchronous pumping may be used to obtain significantly narrowed laser pulses in Ti:Al2O3. Author

**N89-14345*#** Massachusetts Inst. of Tech., Cambridge.
**RESIDUAL INFRARED ABSORPTION IN Ti:Al2O3 CRYSTALS c25**
*In its* Solid State Research 11 Mar. 1988 p 23-30 (For primary document see N89-14342 06-31)
Avail: NTIS HC A04/MF A01 CSCL 13B

The performance of Ti:Al2O3 lasers is impaired generally by an infrared absorption that occurs in the laser output wavelength region. On the basis of data for as-grown and annealed samples cut from Ti:Al2O3 crystals grown by the vertical-gradient-freeze (VGF) technique, we previously proposed that the residual absorption is due to Ti(3+) to Ti(4+) pairs. In this report, we present additional data that confirm this ion-pair model for the residual absorption, which can be attributed to excitation of the 3d electron of the Ti(3+) ion perturbed by the Coulomb field of the neighboring Ti(4+) ion and/or an associated Al vacancy. Author

**N89-14346*#** Massachusetts Inst. of Tech., Cambridge.
**NEW MBE BUFFER FOR MICRON- AND QUARTER-MICRON-GATEGaAs MESFETs c33**
*In its* Solid State Research 11 Mar. 1988 p 31-43 (For primary document see N89-14342 06-31)
Avail: NTIS HC A04/MF A01 CSCL 13B

A new buffer layer has been developed that eliminates backgating in GaAs MESFETs and substantially reduces short-channel effects in GaAs MESFETs with 0.27-micron-long gates. The new buffer is grown by molecular beam epitaxy (MBE) at a substrate temperature of 200 C using Ga and As sub 4 beam fluxes. The buffer is crystalline, highly resistive, optically inactive, and can be overgrown with high quality GaAs. GaAs MESFETs with a gate length of 0.27 microns that incorporate the new buffer show improved dc and RF properties in comparison with a similar MESFET with a thin undoped GaAs buffer. To demonstrate the backgating performance improvement afforded by the new buffer, MESFETs were fabricated using a number of different buffer layers and structures. A schematic cross section of the MESFET structure used in this study is shown. The measured gate length, gate width, and source-drain spacing of this device are 2,98, and 5.5 microns, respectively. An ohmic contact, isolated from the MESFET by mesa etching, served as the sidegate. The MESFETs were fabricated in MBE n-GaAs layers grown on the new buffer and also in MBE n-GaAs layers grown on buffer layers of undoped GaAs, AlGaAs, and GaAs/AlGaAs superlattices. All the buffer layers were grown by MBE and are 2 microns thick. The active layer is doped to approximately 2 x 10 to the 17th/cu cm with silicon and is 0.3 microns thick. Author

**N89-14347*#** Massachusetts Inst. of Tech., Cambridge.
**RF SURFACE RESISTANCE OF YBa2Cu3O(7-x) THIN FILMS**
**c76**
*In its* Solid State Research 11 Mar. 1988 p 45-55 (For primary document see N89-14342 06-31)
Avail: NTIS HC A04/MF A01 CSCL 13B

The excitement engendered by the discovery of the new T sub c oxide superconductors has led to much speculation about practical applications of thin films of these materials in digital and analog electronic devices. Most of these envisioned applications involve high frequency signals for which a detailed knowledge of the surface impedance of the novel superconductors is very important. We have measured the surface resistance of thin films of YBaCuO in the frequency range 0.5 less than f less than 17 GHz using a stripline-resonator method. The stripline procedure also was used to measure the surface resistance of high quality gold and aluminum films; the resistance values obtained agree with values predicted from the measured dc resistance using the Pippard formalism for the anomalous skin effect. The YBaCuO were produced by a multilayer deposition process. The films are formed by e-beam evaporation of 24 layers of Y, Ba, and Cu. Films with the highest transition temperature were obtained using yttria-stabilized zirconia (YSZ) substrates. After deposition, the films are transferred to a furnace where they are annealed in flowing O2 at 850 C for 2h. The furnace then is turned off and allowed to cool to 100 C in about 16 h. Auger profiling of the films made by this process shows that the concentrations of Y, Ba, Cu, and O are uniform to within 1 percent throughout the thickness of the film. Author

**N89-14348*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**LIQUID SHEET RADIATOR APPARATUS Patent Application**
Donald L. Chubb, inventor (to NASA) 15 Sep. 1988 14 p
(NASA-Case-LEW-14295-1; NAS 1.71:LEW-14295-1; US-Patent-Appl-SN-244377) Avail: NTIS HC A03/MF A01 CSCL 13B

An external flow, liquid sheet radiator apparatus adapted for space applications has as its radiating surface a thin stable liquid sheet formed by fluid flow through a very narrow slit affixed to the sheet generator. NASA

**N89-14349#** Allied-Signal Corp., Kansas City, MO.
**INFRARED TEMPERATURE MONITORING AND CONTROL OF FINAL SOLDER-JOINT TEMPERATURE ON FLAT FLEX CABLES**
C. G. Harte Sep. 1988 58 p
(Contract DE-AC04-76DP-00613)
(DE89-000409; BDX-613-3986) Avail: NTIS HC A04/MF A01

This work outlines an infrared monitoring and control strategy to automatically control soldering temperatures regardless of the thermal mass being soldered. The operational theory, equipment, and control circuitry are discussed. The performance of the infrared radiometric microscope as a solder joint temperature controller is determined by measuring the temperature repeatability. This repeatability is compared to the temperature repeatability attained with no infrared temperature feedback and with average temperatures attained by five experienced production operators. The results indicate that superior temperature control can be attained with infrared temperature feedback. DOE

**N89-14350#** Technische Hogeschool, Delft (Netherlands).
**A FAST ION BEAM PATTERN GENERATOR Ph.D. Thesis**
Hendrik Nicolas Slingerland 1988 176 p
(ETN-89-93354) Avail: NTIS HC A09/MF A01

The development of an ion beam pattern generator in order to transfer patterns to semiconductors is described. Special care is given to the minimization of aberrations introduced by the energy spread. A theory concerning the optimization of chromatically limited systems, concluding that a shaped beam system has a higher performance than a Gaussian imaging system is described. An optimized ion source module is realized and an achromatic mass filter developed. A theory concerning the compensation of chromatic deflection aberration is described. ESA

**N89-14351*** National Aeronautics and Space Administration. Pasadena Office, CA.
**JOULE THOMSON REFRIGERATOR Patent**
Chung K. Chan, inventor (to NASA) and John R. Gatewood, inventor (to NASA) 25 Oct. 1988 7 p
(NASA-Case-NPO-17143-1-CU; US-Patent-4,779,428; US-Patent-Appl-SN-105847; US-Patent-Class-62-467; US-Patent-Class-62-514-JT) Avail: US Patent and Trademark Office CSCL 13B

A bi-directional Joule Thomson refrigerator is described, which is of simple construction at the cold end of the refrigerator. Compressed gas flowing in either direction through the Joule Thomson expander valve and becoming liquid, is captured in a container in direct continuous contact with the heat load. The Joule Thomson valve is responsive to the temperature of the working fluid near the valve, to vary the flow resistance through the valve so as to maintain a generally constant flow mass between the time that the refrigerator is first turned on and the fluid is warm, and the time when the refrigerator is near its coldest temperature and the fluid is cold. The valve is operated by differences in thermal coefficients of expansion of materials to squeeze and release a small tube which acts as the expander valve. Official Gazette of the U.S. Patent and Trademark Office

# 32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

**N89-14352#** Helsinki Univ. of Technology, Espoo (Finland). Communications Lab.
**COMBINING SIGNALS OF WIDELY DIFFERING BIT RATES ON FIBER OPTIC SUBSCRIBER LINES**
Michael Hall 1988 143 p
(PB88-210067; TR-T-27; ISBN-951-754-476-6) Avail: NTIS HC A07/MF A01 CSCL 17B

The publication is based on research on optical broad-band transmission in the subscriber loop. The first part of the work is devoted to obtaining a general review on the different methods of combining digital signals of widely differing bit rates. The review covers various time division multiplexing formats, wavelength and

frequency division multiplexing, and methods where the high bit rate signal is modulated by the low bit rate signal. Two multiplexing methods, frequency division multiplexing and code division multiplexing, are analyzed in greater detail. It is shown that code division multiplexing in conjunction with a convenient sampling method for the low bit rate signal results in a simple, flexible and all digital transmission system. GRA

**N89-14353#** Foersvarets Forskingsanstalt, Stockholm (Sweden).
**CURRENT INDUCED BY HEMP (HIGH-ALTITUDE ELECTROMAGNETIC PULSE) ON WIRE ABOVE GROUND**
Lars Joensson and Stefan Westerberg Feb. 1988 24 p
(PB88-212048; FOA-C-30485-4.2) Avail: NTIS HC A03/MF A01 CSCL 20N

An expression is derived for the current induced by a high-altitude electromagnetic pulse (EMP) on a thin wire above ground. The assumption of a thin wire is the only approximation made. Calculations based on the expression are then compared to results derived from transmission-line theory. The authors also discuss a few useful approximations. The conclusions regarding the transmission-line theory is that it describes the exact current quite well in most cases. The highest currents correspond to H polarized pulses and grazing incidence. This is also when the transmission-line theory deviates the most from the correct result. This concerns the magnitude as well as the rise time of the current. GRA

**N89-14354*#** Mississippi State Univ., Mississippi State. Dept. of Electrical Engineering.
**SPACELAB SYSTEM ANALYSIS: A STUDY OF THE MARSHALL AVIONICS SYSTEM TESTBED (MAST) Interim Final Report, Jun. 1987 - Oct. 1988**
Frank M. Ingels, John K. Owens, Steven P. Daniel, F. Ahmad, and W. Couvillion 30 Sep. 1988 213 p
(Contract NAS8-36717)
(NASA-CR-183516; NAS 1.26:183516; MSU-EE-FIN-10A-88)
Avail: NTIS HC A10/MF A01 CSCL 17B

An analysis of the Marshall Avionics Systems Testbed (MAST) communications requirements is presented. The average offered load for typical nodes is estimated. Suitable local area networks are determined. Author

**N89-14355#** Los Alamos National Lab., NM.
**ELECTROMAGNETIC TIME-DOMAIN CALCULATIONS IN TWO AND THREE DIMENSIONS**
K. C. D. Chan 1988 16 p Presented at the International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 7 Nov. 1988
(Contract W-7405-eng-36)
(DE89-000311; LA-UR-88-3206; CONF-881151-6) Avail: NTIS HC A03/MF A01

For some time, computer codes have been available for time-domain calculations of the beam-induced electromagnetic fields in axially symmetric structures (two dimensions). Recently, these codes have been extended to three-dimensional geometries. Time-domain calculations are complementary to frequency-domain calculations in accelerator designs and represent a better approach in some areas. Some of these areas will be reviewed in this paper and an introduction to the computer codes will be given. DOE

**N89-14356#** Los Alamos National Lab., NM.
**TRANSVERSE EFFECTS OF A WAVEGUIDE COUPLING SLOT**
R. K. Cooper, K. C. D. Chan, T. F. Wang, and L. E. Thode 1988 3 p Presented at the Linear Accelerator Conference, Williamsburg, VA, 3 Oct. 1988
(Contract W-7405-eng-36)
(DE89-000340; LA-UR-88-3251; CONF-881049-12) Avail: NTIS HC A02/MF A01

High-power operation of RF cavities may require that the waveguide supplying energy to the system be coupled to the cavity with a large coupling slot. It is a concern that this coupling slot may be so large that appreciable asymmetry will exist in the fields of the fundamental mode and transverse effects will be introduced on the beam. Computation of these effects is complicated by the facts that the fundamental mode frequency must propagate in the waveguide and resonant cavity codes cannot handle energy transfer across the boundaries of the problem. We have successfully computed these effects using 3-D computer codes in MAFIA, both in the frequency and time domains. This paper will report the computed results showing good agreement with experimental measurements and indicating that the transverse effects can be compensated. The results include mode distortions and transverse forces. The methods of calculation will also be described. DOE

**N89-14357#** Sandia National Labs., Albuquerque, N. Mex. Product Evaluation and Control Div.
**TRANSVERTER ASSEMBLY FOR THE ADVANCED INSTRUMENTATION RADAR**
J. M. Simons Aug. 1988 35 p
(Contract DE-AC04-76DP-00789)
(DE89-001036; SAND-88-1419) Avail: NTIS HC A03/MF A01

This report presents a physical description of the S84789 Transverter Assembly which is part of the Advanced Instrument Radar Relay System. The environmental and electrical requirements are also provided along with the descriptions and results of evaluation tests performed to verify the Transverter Assembly design meets all system requirements. All data taken show the Transverter Assembly will perform the required functions as a part of the next assembly. DOE

**N89-14358#** ITT Defense Communications Div., San Diego, CA.
**AUTOMATIC SPEAKER RECOGNITION SYSTEM Final Report**
Alan Higgins and Joe Naylor Jul. 1984 24 p
(Contract N00014-84-C-2130)
(AD-A197980) Avail: NTIS HC A03/MF A01

The Defense Communications Division of ITT (ITTDCD) has developed an automatic speaker recognition (ASR) system that meets the functional requirements defined in NRL's Statement of Work. This report is organized as follows. Chapter 2 is a short history of the development of the ASR system, both the algorithm and the implementation. Chapter 3 describes the methodology of system testing, and Chapter 4 summarizes test results. In Chapter 5, some additional testing performed using GFM test material is discussed. Conclusions derived from the contract work are given in Chapter 6. GRA

**N89-14359#** Illinois Univ., Urbana. Coordinated Science Lab.
**NUMERICAL METHODS TO SOLVE THE PROBLEM OF SCATTERING FROM ELECTRICALLY LARGE BODIES**
A. Chang and R. Mittra Aug. 1988 59 p
(Contract N00014-84-C-0149)
(AD-A198098; UILU-ENG-88-2241) Avail: NTIS HC A04/MF A01 CSCL 17I

An alternative to directly inverting the large MoM matrix is to recast the problem in a form that is suitable for solution via iterative schemes. Although the use of iterative methods may enable one to treat scatterers that are an order of magnitude larger electrically, a close examination of them shows that most of them are not well-suited for handling multiple excitations in an efficient manner. In this report some variational-iteration schemes based on the use of prechosen entire domain basis functions that are suitable not only for treating larger bodies but for handling multiple incident angles as well are suggested. It is shown that, for this type of variational iteration schemes, the choice of an initial guess plays an important role in achieving a rapid convergence. Also, in an effort to further improve the convergence, a hybrid technique, where the method of moments is utilized to generate better gradient vectors in the iterative procedure, is developed. A simple case of scattering from a perfectly conducting or resistively-loaded strip is use to demonstrate the effectiveness of methods. GRA

**N89-14360#** IIT Research Inst., Chicago, IL.
**ELF (EXTREMELY LOW FREQUENCY) COMMUNICATION SYSTEM ECOLOGICAL MONITORING PROGRAM: ELECTROMAGNETIC FIELD MEASUREMENTS AND ENGINEERING SUPPORT, 1987 Technical Report, 1982 - 1987**
David P. Haradem, James R. Gauger, and John E. Zapotosky Aug. 1988 284 p
(Contract N00039-84-C-0070)
(AD-A198303; IITRI-EO6595-1) Avail: NTIS HC A13/MF A01 CSCL 06G

A long-term program for studying possible effects from the operation of the Navy's Extremely Low Frequency (ELF) Communications System is being conducted on biota and ecosystems components in northwestern Wisconsin and the Upper Peninsula of Michigan. Sixteen general types of organisms from three major ecosystems in the ELF system area are being examined. Formulation of an ELF Ecological Monitoring Program was completed in early 1982 by the Department of the Navy, and studies were initiated in late summer of the same year. Beginning in 1983 and continuing during 1984, major activities of the program consisted of characterization of critical aspects of each study, collection of data to validate assumptions made in proposals, and selection of study sites. From 1985 through 1987, activities centered on the operation of full-scale studies. This report documents electromagnetic (EM) field measurements at investigator selected study sites from 1982 through 1987. Other engineering support activities are also described. GRA

**N89-14361#** Naval Research Lab., Washington, DC. Radar Analysis Branch.
**AUTOMATIC DETECTION, TRACKING AND SENSOR INTEGRATION Interim Report**
G. V. Trunk 8 Jun. 1988 60 p
(AD-A198347; NRL-9110) Avail: NTIS HC A04/MF A01 CSCL 17I

This report surveys the state of the art of automatic detection, tracking, and sensor integration. In the area of detection, various noncoherent integrators such as the moving window integrator, feedback integrator, two-pole filter, binary integrator, and batch processor are discussed. Next, the three techniques for controlling false alarms, adapting thresholds, nonparametric detectors, and clutter maps are presented. In the area of tracking, a general outline is given of a track-while-scan system, and then a discussion is presented of the file system, contact-entry logic, coordinate systems, tracking filters, maneuver-following logic, tracking initiating, track-drop logic, and correlation procedures. Finally, in the area of multisensor integration the problems of colocated-radar integration, multisite-radar integration, radar-IFF integration, and radar-DF bearing strobe integration are treated. GRA

**N89-14362#** Southeastern Center for Electrical Engineering Education, Inc., St. Cloud, Fla.
**NETWORK MANAGEMENT OF HIGHLY ADAPTIVE COMMUNICATION NETWORKS Final Technical Report, Aug. 1986 - Jul. 1987**
Jeffrey L. Kennington, Richard V. Helgason, and John M. Colombi Feb. 1988 123 p
(Contract F30602-81-C-0193)
(AD-A198429; RADC-TR-88-17) Avail: NTIS HC A06/MF A01 CSCL 12D

This report documents networking models, network solutions, programming techniques for parallel processing, and parallelled algorithm comparisons. Several papers are contained in the report. An operational research model and associated mathematics are presented for a three node network. A multi-media nodal simulation is developed to optimally assign trunks. A new mathematical approach is shown for solving equal flow problems. This technique makes greater use of the side constraints structure with computational solutions given. Also developed are the mathematical theory and justification of using the quadrant interlocking factorization for solving the simplex algorithm on a parallel processor. Lastly, computational results of solving minimal spanning tree problems, on a parallel processor are presented. GRA

**N89-14363#** Computer Sciences Corp., Falls Church, VA.
**STU-3 SYSTEM LEVEL DESCRIPTION AND NETWORK APPLICATIONS, REVISION Technical Report, for Period Ending 1988**
Roger Wilmot 30 Jun. 1988 40 p
(Contract DCA100-87-C-0013)
(AD-A198514) Avail: NTIS HC A03/MF A01 CSCL 12G

This paper serves as the system level description of the Secure Technical Unite Type 3 (STU-3) and its interfaces in a variety of DOD switched voice network applications. The STU-3 terminal is being developed by the National Security Agency and is intended to replace several thousand existing analog clear voice telephone instruments in the DOD. Its operation and interface to the switched networks is essentially the same as for existing or planned clear voice telephones. The STU-3 family of terminals includes two types of Low Cost Terminals (LCT-1 and LCT-2), and STU-2 compatible terminal (STU-3/A) and a ruggedized mobile/portable terminal (STU-3/MPT). The LCT-1 is intended to be the primary DOD secure voice terminal, whereas the STU-3/A and STU-3/MPT will be used for special applications, e.g., for interoperability with the NATO STU-2 terminals and tactical operations requirements. GRA

**N89-14364#** Naval Postgraduate School, Monterey, CA.
**FINITE ELEMENT ELECTROMAGNETIC SCATTERING: AN INTERACTIVE MICRO-COMPUTER ALGORITHM M.S. Thesis**
Edward M. Connolly Jun. 1988 209 p
(AD-A198552) Avail: NTIS HC A10/MF A01 CSCL 20C

The goal of this thesis effort was to develop an interactive electromagnetic scattering algorithm for personal computer use in the analysis and computer aided design (CAD) of scattering structures. Extensive interactive computer aided design type features have been added to a previously developed finite element computer algorithm which considers scattering from inhomogeneous axisymmetric objects. These computer aided design features allow structures composed of multiple dielectric and/or magnetic materials to be graphically constructed or modified by the user by way of either a keyboard or mouse interface. Bistatic scattering patterns are graphically presented upon completion of the computation for a variety of user specified incident field orientations. GRA

**N89-14365#** Physics and Electronics Lab. TNO, The Hague (Netherlands).
**RADAR CROSS SECTION (RCS) REDUCTION TECHNIQUES FOR SQUARE TRIHEDRAL CORNER REFLECTORS AT 35 GHz: MEASUREMENTS AND THEORETICAL SIMULATIONS**
G. J. M. Janssen, R. V. D. Hulst, and E. Nennie Mar. 1988 43 p
(Contracts A85/KLu/126; A87/KI/064)
(FEL-1988-04; TD-88-1634; ETN-89-93417) Copyright Avail: Physics and Electronics Laboratory TNO, P.O. Box 96864, 2509 JG The Hague, The Netherlands

Radar cross section (RCS) measurements were performed at a square trihedral corner reflector to investigate RCS reduction techniques which use camouflage materials and changes in the construction. The results are compared with an RCS modeling technique. The measurement results show that a significant RCS reduction can be achieved. ESA

**N89-14366#** Air Force Systems Command, Wright-Patterson AFB, OH. Foreign Technology Div.
**ANTENNA ARRAYS WITH INCREASING ACCORDING TO ARITHMETICAL PROGRESSION DISTANCES BETWEEN THE EMITTERS**
Yu. M. Zhidko 13 Jun. 1988 19 p Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy (USSR), v. 5, no. 6, 1962 p 1144-1150
(AD-A198644; FTD-ID(RS)T-0386-88) Avail: NTIS HC A03/MF A01 CSCL 20N

In this translation of a Soviet document the results are analysed

of the numerical computation of radiation patterns for the antenna arrays with the distances between isotropic radiators increasing from the antenna center to its edges according to arithmetical progression. GRA

**N89-14367#** Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
**TWO-DIMENSIONAL SIGNAL PROCESSING AND STORAGE AND THEORY AND APPLICATIONS OF ELECTROMAGNETIC MEASUREMENTS Annual Report, 1 Jan. - 31 Dec. 1987**
R. W. Schafer and D. T. Paris 1 Jan. 1988 43 p
(Contract DAAL03-87-K-0059)
(AD-A198656) Avail: NTIS HC A03/MF A01 CSCL 12F

Specific topics covered are: digital signal processing, parallel processing architectures, two-dimensional optical storage and processing, hybrid optical/digital signal processing, electromagnetic measurements in the time domain, and automatic radiation measurements for near-field and far-field transformations. Contents are: Periodic Scheduling Theory for DSP Multiprocessors; Zero-Reflectivity Surface Relief Gratings on Lossy Materials; Shaped Edge Serrations for Improved Reflector Performance; Iterative Signal Restoration and Estimation; Representation, Coding, and Analysis of Image; Multiprocessors for Digital Signal Processing; Two-Dimensional Optical Information Processing; Two-Dimensional Optical/Electronic Signal Processing; Electromagnetic Measurements in the Time and Frequency Domains; and Automated Measurements for Near- and Far-Field Transforma'ions. GRA

**N89-14368#** Sandia National Labs., Albuquerque, N. Mex. Ground Motion and Seismic Div.
**IMPULSE RESPONSE OF A FREQUENCY-DEPENDENT DELAY**
Samuel D. Stearns and Glenn R. Elliott Dec. 1987 19 p
(Contract DE-AC04-76DP-00789)
(DE88-004793; SAND-87-1295) Avail: NTIS HC A03/MF A01

This report describes three approaches for determining the impulse response of a unit-gain, frequency-dependent delay system. The system is meant to be a model of the electromagnetic phase shift of a homogeneous ionosphere. The three approaches involve: (1) numerical integration, (2) the inverse discrete Fourier transform, and (3) a continuous approximation. The report concludes with an example in which the impulse response is convolved with a source function to produce an output signal. DOE

**N89-14369*#** Communications Satellite Corp., Clarksburg, MD.
**ASSESSMENT OF SATELLITE COMMUNICATIONS QUALITY STUDY. ADDENDUM 1: IMPACT OF PROPAGATION DELAY ON DATA TRANSMISSION Final Report**
S. J. Campanella and D. M. Chitre Nov. 1988 100 p
(Contract NAS3-23790)
(NASA-CR-182229; NAS 1.26:182229) Avail: NTIS HC A05/MF A01 CSCL 17B

The single factor that irrevocably distinguishes geostationary satellite telephony transmission from terrestrial transmission is the greater propagation delay over satellite links. This difference has always provoked vigorous debate over the impact of delay on the subscribers using services incorporating satellite links. The issue is addressed from a variety of directions including human factors studies, laboratory subjective tests that evaluate delay with and without echo, and field tests that obtain data on the opinion of subscribers regarding the quality of service of operational circuits in both national U.S. domestic and international trans-Atlantic network. The tests involved the use of both echo suppressors and echo cancellers. Author

**N89-14370#** Lawrence Livermore National Lab., CA.
**ELECTROMAGNETIC PENETRATION THROUGH FINITE-LENGTH NARROW SLOTS IN PLANAR CONDUCTING SCREENS**
C. M. Butler and E. K. Reed (Clemson Univ., SC.) Jun. 1988 143 p
(Contract W-7405-eng-48)
(DE88-016046; UCRL-21108) Avail: NTIS HC A07/MF A01

Electromagnetic field penetration through a narrow slot in a planar conducting surface is determined in both the time and frequency domains by integral equations methods. Integral equations are derived and solved numerically for the slot electric field, from which the field that penetrates the slotted surface is subsequently determined. Results obtained via the two methods are compared. The validity of both method is established by demonstrating close correlation between data obtained from computations and those determined from measurements. The time-domain equation is solved by a scheme incorporating a finite difference approximation for the differential wave operator in the integral equation. This time-domain scheme obviates the need for matrix inversion, thus allowing the solution to be progressively acquired by marching in time. The frequency-domain integral equation is solved numerically for the slot electric field, or equivalent magnetic current, by a standard technique utilizing a piecewise linear approximation of the unknown and equation enforcement by pulse testing. From knowledge of the equivalent magnetic current, obtained as the solution of the integral equation, the field which penetrates the slot is calculated at various locations for several cases of plane-wave excitation. A narrow slot was cut in a large conducting sheet and an apparatus was fabricated to measure fields. The experiment was conducted at the Lawrence Livermore National Laboratory on a frequency-domain test range employing a monocone source over a large ground plane. The field was measured at various shadow-side loacations for several combinations of excitation and slot length and width. Data were collected for the cases of slots 10 and 15 cm by 1 and 2 mm in the range of 0.5 to 10.5 GHz. DOE

**N89-14371#** Technische Hogeschool, Eindhoven (Netherlands).
**DESIGN OF ERROR CONTROL CODING SCHEMES FOR THREE PROBLEMS OF NOISY INFORMATION TRANSMISSION, STORAGE AND PROCESSING Ph.D. Thesis**
Willibrordus Johanne vanGils 1988 241 p
(B8811768; ETN-89-93341) Avail: NTIS HC A11/MF A01

Using different coding schemes for different parts of messages or the so-called unequal error protection coding scheme gives different protection to different parts of messages. The second coding scheme is designed to be used as an automatically readable product identification code in an automated manufacturing environment. An approach towards error control coding for systems in which digit as well as symbol errors can occur, where a symbol is a position-fixed group of digits, is also described. ESA

**N89-14372** Physics and Electronics Lab. TNO, The Hague (Netherlands).
**PRECISION APPROACH RADARS TWENTHE AND VOLKEL (NETHERLANDS). MULTIPATH PROPAGATION PROBLEMS**
J. C. A. vanGessel Mar. 1988 31 p In DUTCH; ENGLISH summary
(Contract A78/KLu/049)
(FEL-1988-15; TD-88-2572; ETN-89-93418) Copyright Avail: Physics and Electronics Lab. TNO, P.O. Box 96864, 2509 JG 'Gravenhage, Oude Waalsdorperweg 63, 's-Gravenhage, Netherlands

The problems caused by multipath propagation effects in the Precision Approach Radars (PAR) of Air Force bases were solved. Problems such as tracking errors and lock breaks hampered the air traffic control. The problems occurred when the aircraft were on the glide path from 3 miles up to touchdown, corresponding to a sector of 5 deg seen by the PAR. Screens consisting of fences with stainless steel wires with a 2 mm mesh width were placed in certain areas of the airfield, providing a 25 dB damping for a 3 cm wavelength. The results show that these screens solve the multipath propagation problems very effectively. ESA

**N89-14373#** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Afdeling Audiologie.
**SOUND ATTENUATION AND SPEECH TRANSMISSION QUALITY OF FIVE TYPES OF HEADSETS**
A. M. Mimpen Sep. 1987 19 p In DUTCH; ENGLISH summary

(Contract A86/M/161)
(IZF-1987-23; TD-87-4247; ETN-89-93448) Avail: NTIS HC A03/MF A01

Five types of headset intended for use in the Fokker-27 cockpit were compared. Sound attenuation was measured as a function of frequency with 10 subjects. Calculations show that the sound level under the headsets H10-36 and H10-86 in the cockpit does not exceed the recommended damage-risk criterion of 80 dB (A), while for the other headsets this criterion is violated. The speech transmission quality of the microphones, used at a short distance from the lips, is good to excellent (except for the headset H10-86). Speech intelligibility of the telephones is good to moderate. Headset H10-36 is recommended. ESA

**N89-14374*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**LEGISLATED EMERGENCY LOCATING TRANSMITTERS AND EMERGENCY POSITION INDICATING RADIO BEACONS Patent**
William R. Wade, inventor (to NASA) 11 Oct. 1988 12 p Filed 28 Sep. 1984 Supersedes N85-20226 (23 - 11, p 1624)
(NASA-Case-GSC-12892-1; US-Patent-4,777,656; US-Patent-Appl-SN-655606; US-Patent-Class-455-98; US-Patent-Class-455-67; US-Patent-Class-455-115; US-Patent-Class-455-117) Avail: US Patent and Trademark Office CSCL 09A

An emergency locating transmitting (ELT) system is disclosed which comprises a legislated ELT modified with an interface unit and connected by a multiwire cable to a remote control monitor (RCM), typically located at the pilot position. The RCM can remotely test the ELT by disabling the legislated swept tone and allowing transmission of a single tone, turn the ELT on for legislated ELT transmission, and reset the ELT to an armed condition. The RCM also provides visual and audio indications of transmitter operating condition as well as ELT battery condition. Removing the RCM or shorting or opening the interface input connections will not affect traditional ELT operation.
Official Gazette of the U.S. Patent and Trademark Office

**N89-14924*#** Arkansas State Univ., State University. Dept. of Computer Science.
**A FLIGHT TEST DESIGN FOR STUDYING AIRBORNE APPLICATIONS OF AIR TO GROUND DUPLEX DATA LINK COMMUNICATIONS Abstract Only**
Charles H. Scanlon *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 94-96 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 17B

# 33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

**N89-14375#** National Bureau of Standards, Gaithersburg, MD. Center for Electronics and Electrical Engineering.
**CENTER FOR ELECTRONICS AND ELECTRICAL ENGINEERING TECHNICAL PROGRESS BULLETIN COVERING CENTER PROGRAMS, OCTOBER TO DECEMBER 1987 WITH 1988 CEEE EVENTS CALENDAR**
E. Jane Walters, comp. Jun. 1988 41 p
(PB88-232913; NBSIR-88-3762) Avail: NTIS HC A03/MF A01 CSCL 09C

The report is the twenty-first issue of a quarterly publication providing information on the technical work of the National Bureau of Standards Center for Electronics and Electrical Engineering. The issue of the CEEE Technical Progress Bulletin covers the fourth quarter of calendar year 1987. The issue contains abstracts for all Center papers released for publications by NBS in the quarter and citations and abstracts for Center papers published in the quarter. Entries are arranged by technical topic as identified in the table of contents and alphabetically by first author under each subheading within each topic. Unpublished papers appear under the subheading, Released for Publication. Papers published in the quarter appear under the subheading, Recently Published. Following each abstract is the name and telephone number of the individual to contact for more information on the topic (usually the first author). The issue also includes a calendar of Center conferences and workshops planned for calendar year 1988 and a list of sponsors of the work. GRA

**N89-14376*#** Schwartz Electro-Optics, Inc., Orlando, Fla.
**OPTICAL FIBER DATA TRANSFER SYSTEM**
S. H. McMillan Sep. 1988 124 p
(Contract NAS1-18331)
(NASA-CR-181704; NAS 1.26:181704) Avail: NTIS HC A06/MF A01 CSCL 09C

This Phase 2 effort applies the results of Phase 1 to design and fabricate an optical slip ring system for a helicopter rotor blade/wind tunnel application. In this application, there are two assemblies: one on the rotating portion of the mechanical system, one on the stationary portion. The assembly on the rotating portion digitizes and encodes 128 transducer signals from various parts of the blade, and optically transfers data across the noncontacting coupling. Two complete identical independent channels are provided. On the stationary side, the signals are decoded and one channel is transmitted in digital form to a computer for recording and analysis. The second channel reconstructs the analog transducer signals for real time observation. In the opposite direction, eight signal channels enable control signals to be passed from the stationary to the rotating part of the system. Power to the rotor mounted electronics is supplied via power slip rings. The advantages of the optical over the traditional electro-mechanical slip ring method of data transfer across a rotating joint are long life, low-maintenance, immunity to crosstalk, and wider bandwidth. Successful completion of this effort demonstrated that this method is practical and reliable, and can be implemented under difficult conditions of available space, power, environment, and stringent performance and equipment life requirements. Author

**N89-14377*#** Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
**DESIGN OF FEEDBACK CONTROL SYSTEMS FOR UNSTABLE PLANTS WITH SATURATING ACTUATORS**
Petros Kapasouris, Michael Athans, and Gunter Stein 17 Nov. 1988 30 p Proposed for presentation at the Symposium on Nonlinear Control Systems Design, 1989; sponsored by IFAC Sponsored in part by General Electric Corp. Research and Development Center
(Grant NAG2-297)
(NASA-CR-183392; NAS 1.26:183392) Avail: NTIS HC A03/MF A01 CSCL 09C

A new control design methodology is introduced for multi-input/multi-output systems with unstable open loop plants and saturating actuators. A control system is designed using well known linear control theory techniques and then a reference prefilter is introduced so that when the references are sufficiently small, the control system operates linearly as designated. For signals large enough to cause saturations, the control law is modified in such a way to ensure stability and to preserve, to the extent possible, the behavior of the linear control design. Key benefits of this methodology are: the modified feedback system never produces saturating control signals, integrators and/or slow dynamics in the compensator never windup, the directional properties of the controls are maintained, and the closed loop system has certain guaranteed stability properties. The advantages of the new design methodology are illustrated in the simulation of an approximation of the AFTI-16 (Advanced Fighter Technology Integration) aircraft multivariable longitudinal dynamics. Author

**N89-14378#** Ford Motor Co., Dearborn, MI.
**ETX-I: FIRST-GENERATION SINGLE-SHAFT ELECTRIC PROPULSION SYSTEM PROGRAM. VOLUME 2: BATTERY Final Report**
Jun. 1988 742 p
(Contract DE-AC08-80CS-50101)
(DE89-000079; DOE/CS-50101/H1-Vol-2) Avail: NTIS HC A99

The overall objective of this research and development program was to advance ac powertrain technology for electric vehicles (EV). The program focused on the design, build, test, and refinement of an experimental advanced electric vehicle powertrain suitable for packaging in a Ford Escort or equivalent-size vehicle. A Mercury LN7 was subsequently selected for the test bed vehicle. Although not part of the initial contract, the scope of the ETX-I Program was expanded in 1983 to encompass the development of advanced electric vehicle batteries compatible with the ETX-I powertrain and vehicle test bed. The intent of the battery portion of the ETX-I Program was to apply the best available battery technology based on existing battery developments. The battery effort was expected to result in a practical scale-up of base battery technologies to the vehicle battery subsystem level. With the addition of the battery activity, the ETX-I Program became a complete proof-of-concept ac propulsion system technology development program. In this context, the term propulsion system is defined as all components and subsystems (from the driver input to the vehicle wheels) that are required to store energy on board the vehicle and, using that energy, to provide controlled motive power to the vehicle. This report, Volume 2, describes the battery portion of the ETX-I Program. The powertrain effort is reported in Volume 1. DOE

**N89-14379#** Sandia National Labs., Albuquerque, N. Mex.
**DESIGN OF FAULT-TOLERANT CIRCUITS FOR PHOTOVOLTAIC CONCENTRATORS**
C. C. Gonzalez and R. G. Ross, Jr. Jul. 1988 69 p
(Contract DE-AC04-76DP-00789)
(DE89-001062; SAND-88-7027) Avail: NTIS HC A04/MF A01

A methodology for fault-tolerant design of photovoltaic concentrator module and array circuitry presented. Results are provided in the form of example analyses and a complete set of curves giving array power loss versus fraction of open-circuit failures for a broad variety of series-parallel configurations with bypass diodes. Specific curves are provided for single, four, eight, and sixteen-parallel-string source circuits with varying bypass diode frequencies. An example case is presented in a step-by-step fashion to assist the module or array designer in using the above mentioned curves to calculate expected power loss for other concentrator designs. Optimum circuit configurations must also reflect the costs of incorporating circuit redundancy features and the life-cycle tradeoffs associated with repair and replacement of failed modules. To this end, module replacement strategies are also investigated based on a set of projected module and array costs. The results highlight circuit design configurations and module replacement strategies that maximize the array benefit to cost ratio. DOE

**N89-14380#** Purdue Univ., West Lafayette, Ind. School of Electrical Engineering.
**INVESTIGATION OF A NEW CONCEPT IN SEMICONDUCTOR MICROWAVE OSCILLATORS Annual Report, 1 May 1987 - 30 Apr. 1988**
James A. Cooper, Jr. 31 May 1988 6 p
(Grant AF-AFOSR-0193-85; AF Proj. 2305)
(AD-A198039; AFOSR-88-0781TR) Avail: NTIS HC A02/MF A01 CSCL 09A

The contiguous domain oscillator employs a 2-D electrostatic geometry to create conditions where a sequence of contiguous charge domains develop spontaneously in the channel region of an appropriately modified MESFET or MODFET device. These contiguous domains drift along the channel producing microwave oscillations in the drain current. Computer simulations indicate the device will be tunable over decades by control of the gate-to-source voltage. The ITT Gallium Arsenide Technology Center in Roanoke, VA, has fabricated two 2-inch wafers of MESFET-compatible oscillator devices for our use. Each wafer contains several thousand devices, and initial screen indicates near 100 percent yield at DC test. We discovered a design oversight which produced an excessive gate-to-channel voltage drop when biased to the voltages necessary for microwave testing, resulting in immediate failure of the device under these conditions. By suitable reprocessing at Purdue, we have eliminated this problem and now have devices which can withstand DC biasing at the required fields. This means we can now operate the devices in the CW mode for microwave testing. GRA

**N89-14381#** Missouri Univ., St. Louis. Dept. of Physics.
**FUNDAMENTAL QUANTUM 1/F NOISE IN ULTRASMALL SEMICONDUCTOR DEVICES AND THEIR OPTIMAL DESIGN PRINCIPLES Annual Report No. 3, 1 May 1985 - 30 May 1988**
Peter H. Handel 31 May 1988 86 p
(Grant AF-AFOSR-0130-85; AF Proj. 2305)
(AD-A198462; AFOSR-88-0904TR) Avail: NTIS HC A05/MF A01 CSCL 12I

During this period I have extended the second-quantized derivation of quantum 1/f noise shown in the Second Annual Report to the general case of N particles present in the final state. I also have derived the quantum 1/f cross correlations and the corresponding cross-correlation spectra, which are important for the calculation of quantum 1/f noise in kinetic coefficients such as the mobility and the diffusion coefficient of the current carriers in solids. In order to better explain the foundations of quantum 1/f theory, I have given a derivation of the quantum 1/f Schroedinger fields from quantum electrodynamics with the use of coherent states. Finally, I have given a direct derivation of the quantum 1/f effect in time and space. In terms of applications, a quantum 1/f noise study of MIS detectors was performed. Experimentally, with the collaboration of the group of Prof. A van der Ziel, an excellent experimental verification of quantum 1/f theory was performed on semiconductor diodes, transistors and vacuum tubes, and a review article on the results of the experimental application and verification of my theory was published by A. van der Ziel in the Proceedings of IEEE in March 1988. GRA

**N89-14382#** Arizona Univ., Tucson. Dept. of Chemistry.
**COMPARISON OF CHARGE TRANSFER DEVICE AND PHOTOMULTIPLIER TUBE PERFORMANCE FOR EXTREMELY LOW PHOTON FLUXES Technical Report No. 59**
Jonathan V. Sweedler and M. B. Denton 4 Feb. 1988 4 p
(Contract N00014-86-K-0316)
(AD-A198594) Avail: NTIS HC A02/MF A01 CSCL 14B

New solid state silicon arrays which outperform photon counting photomultiplier tubes (PMTs) under extreme low light fluxes are described. The results of the evaluation of the spectroscopically pertinent characteristics of several charge transfer device (CTD) detectors are presented. The characteristics of these multichannel detectors include peak quantum efficiencies exceeding 80 percent, read noises of approximately ten charge carriers and virtually no dark current. The potential for these non-intensified silicon devices to outperform PMTs in many low light level situations is demonstrated. The signal-to-noise ratios for several CTD detectors are contrasted to the signal-to-noise ratio performance of the best photon counting PMTs for a variety of low flux situations. Two approaches to creating a single element detector with the same optical format and larger dynamic range than common photon PMTs are described. The results of the evaluation of a prototype large single element charge injection device are presented. Combining a 1,000,000 simple dynamic range with the ability to vary integration times over four orders of magnitude allows this detector to quantity photon fluxes ranging over ten orders of magnitude. GRA

**N89-14383#** Oak Ridge National Lab., Tenn. Physics Div.
**BASIC STUDIES OF GASES FOR FAST SWITCHES Final Report, 1 Oct. 1982 - 31 Mar. 1988**
S. R. Hunter and L. G. Christophorou Aug. 1988 115 p Prepared

in cooperation with Tennessee Univ., Knoxville
(Contracts N00014-82-F-0123; DE-AC05-84OR-21400)
(AD-A198641; ORNL/TM-10844) Avail: NTIS HC A06/MF A01 CSCL 07B

This final report includes an outline of the operation of diffuse discharge switches in pulsed power energy storage circuits, the methods by which the operation of these switches may be optimized, and the measurements we have performed on several gas mixtures which exhibit these optimized characteristics. The goal of the program has been to identify these optimization procedures, and using basic data on electron atom and electron molecule collision processes, to find gas mixtures in which the transport properties of the electrons in the gas discharges are tailored to match these optimization requirements. Using these criteria, we have found several gas mixtures which have very desirable characteristics for use in these switches. The potential of these gas mixtures has been demonstrated in recent switching experiments which have shown considerable operational improvements when these gases were used. GRA

**N89-14384*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**LASER DOPPLER VELOCIMETER MULTIPLEXER INTERFACE FOR SIMULTANEOUS MEASURED EVENTS Patent**
Dean R. Harrison, inventor (to NASA) and James L. Brown, inventor (to NASA) 18 Oct. 1988 24 p Filed 22 Apr. 1985 Supersedes N85-30202 (23 - 19, p 3258)
(NASA-Case-ARC-11536-1; US-Patent-4,779,222; US-Patent-Appl-SN-725714; US-Patent-Class-364-900; US-Patent-Class-356-28.5; US-Patent-Class-342-195) Avail: US Patent and Trademark Office CSCL 09A

A laser Doppler velocimeter multiplexer interface includes an event pulse synchronizer which synchronizes data pulses from events A, B, and C. Clock control is connected to receive timing information on the data pulses from the synchronizer. Displays are connected to receive clock signals from the clock control for indicating a data rate for each of the measured events A, B, and C. The display is connected to receive clock signals from the clock control to indicate a coincidence rate between data pulses for any selected combination of the measured events A, B, and C. A multiplexer receives the data pulses from the events A, B, and C and rate data from the clock control. The multiplexer has output for supplying the data pulses and rate data to a single input of a data processing system. A multiplexer control is connected to supply control signals to the multiplexer for selecting the event data pulses and the rate data for output from the multipiexer. The multiplexer control receives start signals from the pulse synchronizer and user selected inputs for desired outputs from the multiplexer.
Official Gazette of the U.S. Patent and Trademark Office

**N89-14385*** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**FREQUENCY DOMAIN LASER VELOCIMETER SIGNAL PROCESSOR Patent**
James F. Meyers, inventor (to NASA), John W. Stoughton, inventor (to NASA), James I. Clemmons, Jr., inventor (to NASA), Sharad V. Kanetkar, inventor (to NASA), and Andreas E. Savakis, inventor (to NASA) (Old Dominion Univ., Norfolk, Va.) 22 Nov. 1988 12 p Filed 24 Nov. 1986 Supersedes N87-18761 (25 - 11, p 1474)
(NASA-Case-LAR-13552-1-CU; US-Patent-4,786,168; US-Patent-Appl-SN-933941; US-Patent-Class-356-28.5; US-Patent-Class-324-77-R; US-Patent-Class-324-77-E; US-Patent-Class-324-78-D; US-Patent-Class-324-78-F; US-Patent-Class-364-484; US-Patent-Class-377-39) Avail: U.S. Patent and Trademark Office CSCL 09A

A laser velocimeter signal processor for measuring the signal frequency within a signal burst was invented. The input signal is converted to digital by an analog to digital converter and then shifted into shift registers. An automatic gain circuit controls the gain of the input signal. A signal integration circuit determines when a signal burst has been captured by the shift registers and then transfers the contents of the registers to data latches. The data in the data latches is processed by digital bandpass filters, square law detectors, burst counters and a signal processor to determine the frequency of the signal within the captured signal burst. Official Gazette of the U.S. Patent and Trademark Office

**N89-14344*#** Massachusetts Inst. of Tech., Cambridge.
**SYNCHRONOUSLY PUMPED MODE-LOCKED Ti:Al2O3 LASERS**
*In its* Solid State Research 11 Mar. 1988 p 13-22 (For primary document see N89-14342 06-31)
Avail: NTIS HC A04/MF A01 CSCL 13B

**N89-14346*#** Massachusetts Inst. of Tech., Cambridge.
**NEW MBE BUFFER FOR MICRON- AND QUARTER-MICRON-GATEGaAs MESFETs**
*In its* Solid State Research 11 Mar. 1988 p 31-43 (For primary document see N89-14342 06-31)
Avail: NTIS HC A04/MF A01 CSCL 13B

# 34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

**N89-14386*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**EXPERIMENTAL RESULTS FOR A TWO-DIMENSIONAL SUPERSONIC INLET USED AS A THRUST DEFLECTING NOZZLE**
Albert L. Johns and Paul L. Burstadt 1984 14 p Presented at the 19th Joint Propulsion Conference, Seattle, WA, 27-29 Jun. 1983; cosponsored by AIAA, SAE and ASME Sponsored by NASA, Washington, D.C. Original contains color illustrations
(NASA-TM-83439; E-1737; NAS 1.15:83439) Avail: NTIS HC A03/MF A01 CSCL 20D

Nearly all supersonic V/STOL aircraft concepts are dependent on the thrust deflecting capability of a nozzle. In one unique concept, referred to as the reverse flow dual fan, not only is there a thrust deflecting nozzle for the fan and core engine exit flow, but because of the way the propulsion system operates during vertical takeoff and landing, the supersonic inlet is also used as a thrust deflecting nozzle. This paper presents results of an experimental study to evaluate the performance of a supersonic inlet used as a thrust deflecting nozzle for this reverse flow dual fan concept. Results are presented in terms of nozzle thrust coefficient and thrust vector angle for a number of inlet/nozzle configurations. Flow visualization and nozzle exit flow survey results are also shown. Author

**N89-14387** Clarkson Univ., Potsdam, NY.
**CONSTITUTIVE RELATIONS FOR RAPIDLY SHEARED GRANULAR FLOWS: A MONTE CARLO FORM BASED ON THE KINETIC THEORY OF DENSE GASES Ph.D. Thesis**
Mark Alan Hopkins 1988 102 p
Avail: Univ. Microfilms Order No. DA8808025

A Monte Carlo method is derived for the calculation of the constitutive relations for systems of identical particles in a rapidly deforming simple shear flow. Beginning with a pair of particles in contact, the detailed collision mechanics are examined. Taking an approach based on the methods of the kinetic theory of dense gases, in which it is assumed that molecular chaos exists in the system, a familiar integral expression for the frequency of collision is derived. The Monte Carlo method is developed from this beginning in which no prior assumptions about the single particle velocity distribution are necessary. From the expression for the frequency of collision a normalized probability density function of pair collisional configurations is derived. The Monte Carlo method

is first verified by simulating an equilibrium system of elastic spheres. The Monte Carlo results are compared with the results of full computerized simulations of identical systems. An extension of the method to systems of identical, rough regular polygons in a rapidly deforming simple shear flow is described. The results are again checked against the full computer simulation. The validity and usefulness of the Monte Carlo method in studying the constitutive relations for a rapidly deforming simple shear flow of uniform granular material is demonstrated. This method has great potential to study more complicated flows of fluid-solid mixtures.
Dissert. Abstr.

**N89-14388** Minnesota Univ., Minneapolis.
**COUPLED THREE-DIMENSIONAL CONDUCTION AND NATURAL CONVECTION HEAT TRANSFER Ph.D. Thesis**
Anil Kumar Tolpadi 1987 175 p
Avail: Univ. Microfilms Order No. DA8805765

A numerical and experimental investigation of three-dimensional natural convection heat transfer coupled with conduction was performed. This general problem is of great importance because of its widespread applicability in areas such as compact natural convection heat exchangers, cooling of electronic equipment, and porous media flows. The determination of flow patterns and heat transfer coefficients in such situations is necessary because of its practical use in various industries. A vectorized finite difference code was developed for the Cray-2 supercomputer which has the capability of simulating a wide class of three-dimensional coupled conduction-convection problems. This program numerically solves the transient form of the complete laminar Navier-Stokes equations of motion using the vorticity-vector potential methods. Using this program, numerical solutions were obtained for 3-D natural convection from a horizontal isothermal heat exchanger tube with an attached circular cooling fin array. Experiments were performed to measure three-dimensional temperature fields using Mach-Zehnder interferometry. Software was developed to digitize and process fringe patterns and inversion algorithms used to compute the 3-D temperature field. Dissert. Abstr.

**N89-14389** Toledo Univ., Ohio.
**A FINITE DIFFERENCE ANALYSIS OF THE HEAT TRANSFER IN PERIODIC CAVITY FLOWS Ph.D. Thesis**
Steven Roy Huebner 1987 184 p
Avail: Univ. Microfilms Order No. DA8806713

The heat transfer effects of periodic cavity flows relative to steady flows which have the same time averaged mass flux are determined. The cavity flows investigated were induced by either an upper wall oscillating horizontally or by the periodic injection and expulsion of fluid through slot jets located on each of the side walls at the horizontal centerline of the cavity. The flows investigated were assumed two dimensional with Reynolds numbers ranging from 15 to 750 for the driven cavity and from 1 to 50 for the cavity with an imposed mass flux. The results indicate that for the cavity with an imposed mass flux, the rate of heat transfer may be increased, decreased or remain unchanged, depending on the Reynolds number and frequency of the pulsations at which the fluid is introduced into the cavity. Greater Reynolds numbers combined with higher frequency pulsations have exhibited the greatest increase in the rate of heat transfer of the cases studied. The higher Reynolds numbers prevent the heat transfer from being controlled by conduction. The high frequency pulsations apparently enhances the convective flux of fluid between the primary jet which traverses the cavity and the recirculation zones. Dissert. Abstr.

**N89-14390*#** National Bureau of Standards, Gaithersburg, MD.
**WORKING FLUID SELECTION FOR SPACE-BASED TWO-PHASE HEAT TRANSPORT SYSTEMS**
Mark O. McLinden Aug. 1988 76 p Sponsored by NASA, Goddard Space Flight Center, Greenbelt, MD
(NASA-CR-183324; NAS 1.26:183324; PB88-243373; NBSIR-88-3812) Avail: NTIS HC A05/MF A01 CSCL 20D

The working fluid for externally-mounted, space-based two-phase heat transport systems is considered. A sequence of screening criteria involving freezing and critical point temperatures and latent heat of vaporization and vapor density are applied to a data base of 860 fluids. The thermal performance of the 52 fluids which pass this preliminary screening are then ranked according to their impact on the weight of a reference system. Upon considering other nonthermal criteria (flammability, toxicity, and chemical stability) a final set of 10 preferred fluids is obtained. The effects of variations in system parameters is investigated for these 10 fluids by means of a factorial design. GRA

**N89-14391** New South Wales Univ., Kensington (Australia). School of Mechanical and Industrial Engineering.
**HEAT EXCHANGER OPTIMIZATION M.S. Thesis**
Ik-Sang Lee 1987 3 p
Avail: Issuing Activity

A computer code was developed which would analyze a shell-and-tube heat exchanger, and it was used in conjunction with a computer code for numerical optimization program. The problem is to find the smallest shell-and-tube heat exchanger with the minimum number of exchangers in series and parallel which will satisfy the heat duty and pressure drop requirements within the constraints imposed. The MINOS (Modular In-core Nonlinear Optimization System) programming code was used in the optimization of a shell-and-tube heat exchanger. MINOS purpose is to optimize a user written objective function. For heat exchanger design, it is necessary to develop two FORTRAN subroutines in order to analyze a heat exchanger. To get the generalized optimal heat exchanger design, the calculation method and data in Process Heat Transfer by Kern, was used. All the data, including material specifications were given as typical. Three types of case studies were studied and are discussed. Author

**N89-14392*** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
**CAPILLARY HEAT TRANSPORT AND FLUID MANAGEMENT DEVICE Patent**
James W. Owen, inventor (to NASA) 13 Sep. 1988 9 p Filed 30 Jun. 1987 Supersedes N87-29769 (25 - 24, p 3309)
(NASA-Case-MFS-28217-1; US-Patent-4,770,238; US-Patent-Appl-SN-067844; US-Patent-Class-165-104.26; US-Patent-Class-165-104.14; US-Patent-Class-122-366) Avail: US Patent and Trademark Office CSCL 20D

A passive heat transporting and fluid management apparatus including a housing in the form of an extruded body member having flat upper and lower surfaces is disclosed. A main liquid channel and at least two vapor channels extend longitudinally through the housing from a heat input end to a heat output end. The vapor channels have sintered powdered metal fused about the peripheries to form a porous capillary wick structure. A substantial number of liquid arteries extend transversely through the wicks adjacent the respective upper and lower surfaces of the housing, the arteries extending through the wall of the housing between the vapor channels and the main liquid channel and open into the main liquid channel. Liquid from the main channel enters the artery at the heat input end, wets the wick and is vaporized. When the vapor is cooled at the heat output end, the condensed vapor refills the wick and the liquid reenters the main liquid channel.
Official Gazette of the U.S. Patent and Trademark Office

**N89-14393#** North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
**ANALYSIS OF TRANSPORT MECHANISMS IN DENSE FUEL DROPLET SPRAYS Progress Report, 1 Jun. 1987 - 31 May 1988**
C. Kleinstreuer Feb. 1988 34 p
(Contract DE-FG05-87ER-13728)
(DE88-017256; DOE/ER-13728/1) Avail: NTIS HC A03/MF A01

A basic understanding of the effects of closely spaced, evaporating droplets on the transfer processes in dense sprays are of importance for the improved design of fuel droplet combustion and other spray systems. The development of two different modeling approaches and preliminary results are

presented for transient laminar axisymmetric two-phase flow past single and multiple droplets. The first approach is a finite element solution of the complete transport equations for convection heat transfer between a hot gas stream and closely-spaced volatile fuel droplets. The resulting computer simulation model is validated with empirical data sets for flow around a single, heated sphere in the Reynolds number range of 10 less than or equal to Re sub d less than or equal to 200. Results of different case studies are given for single fuel droplet vaporization and for flow past a linear array of multiple spherical droplets. The second approach, ultimately based on the insight gained from the exact numerical solution, is a boundary-layer type simulation. For illustration purposes, results are given for the dynamics of interacting water drops in a trace gas environment. Semi-empirical correlations have been used for the drag/interaction force coefficient and for the near-wake velocities. DOE

**N89-14394#** Los Alamos National Lab., NM. Theoretical Div.
**DYNAMICS OF UNBOUND VORTICES IN THE 2-DIMENSIONAL XY AND ANISOTROPIC HEISENBERG MODELS**
F. G. Mertens, A. R. Bishop, M. E. Gouvea, and G. M. Wysin (Kansas State Univ., Manhattan.) 1988 11 p Presented at the International Conference on Magnetism, Paris, France, 25 Jul. 1988
(Contract W-7405-eng-36)
(DE89-000371; LA-UR-88-2988; CONF-880705-9) Avail: NTIS HC A03/MF A01

Assuming an ideal gas of vortices above the Kosterlitz-Thouless transition temperature, the dynamic form factors are calculated. For the in-plane correlations a Lorentzian central peak is predicted which is independent of the vortex size and shape. However, for the out-of-plane correlations the velocity dependence of the vortex structure is decisive for the occurrence of a Gaussian central peak. Both results are in good agreement with combined Monte Carlo-molecular dynamics simulations. DOE

**N89-14395#** Sandia National Labs., Albuquerque, N. Mex.
**USE OF TIME-RESOLVED TECHNIQUES FOR STUDYING SHOCK-INDUCED VAPORIZATION**
J. R. Asay 1988 4 p Presented at the Shock Wave Symposium, Pullman, WA, 1 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE88-017168; SAND-88-2426; CONF-8809109-4) Avail: NTIS HC A02/MF A01

The rapid vaporization of materials exposed to intense shock waves is important in a variety of applications, such as high-velocity projectile penetration, meteorite impact and laser heating. In these applications, it is often necessary to assess the degree of material damage produced by vaporization with the use of computer simulations of material response in expanded states. In these problems, technical issues involve the question of whether vaporization occurs on sub-microsecond time-scales and whether equilibrium theories of expanded state response can be used on these time scales. In this paper, we describe a new experimental technique which is useful for studying the expanded response of materials. In this method, a thin foil is shock-loaded to high pressures with plate-impact techniques and released into the liquid-vapor coexistence region. Vapor products formed during expansion are allowed to expand one-dimensionally across a vacuum gap and stagnate against an interferometer gauge, which provides a time-resolved history that can be used to evaluate theories of the expanded state. DOE

**N89-14396#** Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
**UNDEREXPANDED NONCONDENSING TURBULENT GAS JETS IN LIQUIDS Final Report, 1 Aug. 1985 - 30 Aug. 1988**
E. Loth and G. M. Faeth Aug. 1988 79 p
(Contract N00014-85-K-0604)
(AD-A197939) Avail: NTIS HC A05/MF A01 CSCL 07D

The structure of turbulent noncondensing round and plane air jets submerged in still water were investigated experimentally. Both adapted and underexpanded jets were considered, the latter with underexpansion ratios up to 8:1. Measurements included flow visualization, using flash photography and shadowgraphs as well as high-speed motion-picture photography; mean void fraction distributions, using gamma-ray absorption; entrainment rates, using laser-Doppler aneomometry; and mean static pressures, using static-pressure probes. Present measurements and the earlier results of Bell et al. (1972), Tross (1974) and Carreau et al. (1985) were used to evaluate analysis of the process. The analysis was based on the locally-homogeneous-flow approximation (relative velocities between the phases neglected) and the effective-adapted-jet approximation for underexpanded jets. GRA

**N89-14397#** Naval Postgraduate School, Monterey, CA.
**DYNAMIC STALL COMPUTATIONS USING A ZONAL NAVIER-STOKES MODEL M.S. Thesis**
Jack H. Conroyd, Jr. Jun. 1988 212 p
(AD-A197942) Avail: NTIS HC A10/MF A01 CSCL 01A

A zonal Navier-Stokes model, is installed and verified on the NASA Ames Cray X/MP-48 computer and is used to calculate the flow field about a NACA 0012 airfoil oscillating in pitch. Surface pressure distributions and integrated lift, pitching moment, and drag coefficient versus angle of attack are compared to existing experimental data for four cases and existing computational data for one case. These cases involve deep dynamic stall and fully detached flow at and below a freestream Mach number of .184. The flow field about the oscillating airfoil is investigated through the study of pressure, vorticity, local velocity and stream function. Finally, the effects of pitch rate on dynamic stall are investigated. GRA

**N89-14398#** Naval Postgraduate School, Monterey, CA.
**AN ADVANCED STUDY OF NATURAL CONVECTION IMMERSION COOLING OF A 3 X 3 ARRAY OF SIMULATED COMPONENTS IN AN ENCLOSURE FILLED WITH DIELECTRIC LIQUID M.S. Thesis**
Terry J. Benedict Jun. 1988 113 p
(AD-A197962) Avail: NTIS HC A06/MF A01 CSCL 13A

An experimental study has been conducted to examine the three dimensional natural convection heat transfer from an array of simulated electronic components immersed in a chamber filled with Fluorinert FC-75, a commercially available dielectric liquid. The top and bottom walls of the chamber were maintained at uniform temperature while all other surfaces were insulated. The simulated components were in the form of a 3 x 3 array of discrete protruding aluminum blocks, each with geometrical dimensions of a 20 Pin Dual-inline-Package. The components were electrically powered resulting in a range of energy dissipation levels from 0.1 to 3.1 watts. Flow visualization in steady state was accomplished using Magnesium particles illuminated by a Helium Neon laser plane. Component surface temperature measurements allowed determination of the heat transfer characteristics. Timewise fluctuations of temperature at several locations were measured with increasing power levels. GRA

**N89-14399#** Naval Research Lab., Washington, DC. Lab. for Computational Physics and Fluid Dynamics.
**MOMENTUM FLUX INCREASES AND COHERENT-STRUCTURE DYNAMICS IN A SUBSONIC AXISYMMETRIC FREE JET**
F. F. Grinstein, F. Hussain (Houston Univ., TX.), and E. S. Oran 19 Aug. 1988 57 p
(AD-A198360; NRL-MR-6279) Avail: NTIS HC A04/MF A01 CSCL 20D

The spatial evolution of a high Reynolds number, axisymmetric free jet is computed numerically with a compressible, two-dimensional, finite-difference Flux-Corrected Transport algorithm and appropriate inflow and outflow boundary conditions. The simulated flow fields are examined to obtain an insight into the physics of large-scale organized structures in the transition region and to investigate the effects of the initial conditions, Mach number and controlled axial excitation. Contrary to the traditionally accepted notion of isobaric free jet flow, the results show significant streamwise increases in the momentum flux consistent with

previously recorded experimental data. The results are discussed in terms of instantaneous velocity, vorticity and pressure fields. GRA

**N89-14400#** Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH.
**A NUMERICAL SIMULATION OF THE FLOW FIELD AND HEAT TRANSFER IN A RECTANGULAR PASSAGE WITH A TURBULENCE PROMOTER Final Report, Jun. - Sep. 1987**
Brian R. Becker and Richard B. Rivir Jun. 1988 92 p
(AD-A198579; AFWAL-TR-88-2007) Avail: NTIS HC A05/MF A01 CSCL 20D

A numerical study of the flow field and heat transfer in a turbine blade control cooling passage is described. Attention is focused on a short straight section of the rectangular passage which includes a single turbulator protruding from its floor. The two-dimensional, transient, Reynolds averaged Navier Stokes, continuity and energy equations are iterated to a steady state solution using the MacCormick explicit predictor-corrector algorithm. Turbulence closure is achieved through the use of the Baldwin-Lomax form of the Cebeci-Smith algebraic two layer eddy viscosity model. Plots of skin friction, local heat transfer rate, streamlines, velocity profiles and temperature profiles are given. It was found that the widely used Reynolds Analogy greatly underpredicts the heat transfer rate as given by a direct calculation using Fourier's law. GRA

**N89-14401*#** Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
**NAVIER-STOKES CALCULATIONS OF TRANSONIC FLOWS PAST CAVITIES Final Report, 1 Jan. - 31 Aug. 1988**
Oktay Baysal and Shivakumar Srinivasan Washington NASA Jan. 1989 26 p
(Contract NCC1-121)
(NASA-CR-4210; NAS 1.26:4210) Avail: NTIS HC A03/MF A01 CSCL 20D

A computational investigation of subsonic and transonic flows past 3-D deep transitional cavities is presented. Computational simulations of these self-induced oscillatory flows were generated through time-accurate solutions of the Reynolds averaged full Navier-Stokes equations, using the explicit MacCormack scheme. The Reynolds stresses were included through the Baldwin-Lomax algebraic turbulence model with certain modifications. Two cases were computed to demonstrate the capability of the numerical scheme in modeling the complex 3-D flow features inside a cavity. The results from an experimental investigation were used not only to benchmark the computations, but also to widen the database used for the discussions and conclusions. The computational results include instantaneous and time averaged flow properties everywhere in the computational zone. Time series analyses were performed for the instantaneous pressure values on the cavity floor. The features of deep and transitional cavity flows, and the effect of the sidewall on the cavity flow flowfield are illustrated through computational graphics. Author

**N89-14402*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**EFFECT OF HEAT RELEASE ON THE SPATIAL STABILITY OF A SUPERSONIC REACTING MIXING LAYER Final Report**
T. L. Jackson and C. E. Grosch Nov. 1988 13 p Prepared in cooperation with Old Dominion Univ., Norfolk, VA Submitted for publication
(Contracts NAS1-18107; NAS1-18605)
(NASA-CR-181753; ICASE-88-68; NAS 1.26:181753) Avail: NTIS HC A03/MF A01 CSCL 20D

A numerical study of the stability of compressible mixing layers in which a diffusion flame is embedded is described. The mean velocity profile has been approximated by a hyperbolic tangent profile and the limit of infinite activation energy taken, which reduces the diffusion flame to a flame sheet. The addition of combustion in the form of a flame sheet was found to have important, and complex, effects on the flow stability. Author

**N89-14403*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**EFFECTS OF CORE TURBULENCE ON JET EXCITABILITY**
Reda R. Mankbadi, Ganesh Raman (Sverdrup Technology, Inc., Cleveland, Ohio.), and Edward J. Rice [1989] 11 p Prepared for presentation at the 2nd Shear Flow Control Conference, Tempe, AZ, 13-16 Mar. 1989; sponsored by AIAA Prepared in cooperation with Cairo Univ. (Egypt)
(SAA-C99066G)
(NASA-TM-101405; ICOMP-88-21; E-4497; NAS 1.15:101405; AIAA-89-0966) Avail: NTIS HC A03/MF A01 CSCL 20D

The effects of varying freestream core turbulence on the evolution of a circular jet with and without tonal excitation are examined. Measurements are made on an 8.8 cm diameter jet at a Mach number of 0.3. The jet is excitated by plane waves at Strouhal number 0.5. For the excited and unexcited cases the turbulence level is varied by screens and grids placed upstream of the nozzle exit. The experiment results are compared with a theoretical model which incorporates a variable core turbulence and considers the energy interactions between the mean flow, the turbulence and the forced component. Both data and theory indicate that increasing the freestream turbulence diminishes the excitability of the jet and reduces the effect of excitation on the spreading rate of the jet. Author

**N89-14905*#** Valparaiso Univ., Ind. Dept. of Mechanical Engineering.
**AN INVESTIGATION OF TURBULENCE MODELS Abstract Only**
Michael L. Doria *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 55-56 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20D

**N89-14916*#** Puerto Rico Univ., Mayaguez. Dept. of Mechanical Engineering.
**TRANSIENT HEAT TRANSFER FROM SHRINKING LOX-DROP Abstract Only**
Nenad N. Kondic *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 78-80 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20D

**N89-14917*#** Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
**MODELING OF TRANSITIONAL FLOWS Abstract Only**
Thomas S. Lund *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 81-83 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20D

**N89-14918*#** Mississippi State Univ., Mississippi State. Dept. of Mathematics and Statistics.
**OVERLAPPING GRIDS FOR FLOW FIELD CALCULATIONS Abstract Only**
Charles Wayne Mastin *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 84-85 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20D

**N89-14928*#** Ohio State Univ., Columbus. Dept. of Mathematics.
**NUMERICAL METHODS FOR TURBULENT FLOW Abstract Only**
James C. Turner, Jr. *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 102 (For primary document see N89-14896

06-80)
Avail: NTIS HC 07/MF A01 CSCL 20D

# 35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

**N89-14404** Colorado Univ., Boulder.
**NEW ABSOLUTE GRAVITY INSTRUMENTS FOR PHYSICS AND GEOPHYSICS Ph.D. Thesis**
Timothy Michael Niebauer 1987 166 p
Avail: Univ. Microfilms Order No. DA8808294

A new generation of highly accurate absolute gravimeters was designed, built, and tested. The instruments record the motion of a freely falling object using a laser interferometer. The occurrence of each optical fringe is timed and provides an accurate measurement of g. The accuracy is 3 to 5 microGal or 3 parts in 10 to the 9th of the surface gravity value. This accuracy is equivalent to about 1 cm vertical motion of the earth's crust. The instruments were compared with each other and with most of the existing absolute gravimeters in the world at an international conference held at the Bureau International des Poids et Mesures, Sevres, France. The results of the intercomparisons were successful. A direct test of the principle of equivalence was performed in which two different materials (copper and uranium) were dropped simultaneously and the differential motion was monitored interferometrically. It was found that they fell at the same rate to 5 parts in 10 billion. This result placed new limits on a recently proposed fifth force in nature. Dissert. Abstr.

**N89-14405#** National Bureau of Standards, Gaithersburg, MD.
**TRACEABILITY OF LASER INTERFEROMETRIC LENGTH MEASUREMENTS Final Report**
Howard P. Layer and W. Tyler Estler Jun. 1988 8 p
(PB88-225677; NBS/TN-1248) Avail: NTIS HC A02/MF A01 CSCL 14B

The National Bureau of Standards (NBS) maintains the standard of length in accordance with the definition of the meter, adopted by the General Conference of Weights and Measures (1983). The standard is used within the NBS to form a consistent system of units which are used in NBS calibration services. Author

**N89-14406*#** Physical Sciences, Inc., Andover, Mass.
**MULTICOLOR PYROMETER FOR MATERIALS PROCESSING IN SPACE, PHASE 2 Quarterly Report No. 5, 1 Jun. - 31 Aug. 1988**
Michael Frish, Jonathan Frank, and Henry Beerman Nov. 1988 29 p Prepared in cooperation with Jet Propulsion Lab., California Inst. of Tech., Pasadena
(Contract NAS7-1002)
(NASA-CR-183358; NAS 1.26:183358; PSI-1038/TR-876) Avail: NTIS HC A03/MF A01 CSCL 14B

The program goals were to design, construct, and program a prototype passive imaging pyrometer capable of measuring, as accurately as possible, the temperature distribution across the surface of a moving object suspended in space. B.G.

**N89-14407*** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**ULTRASONIC DEPTH GAUGE FOR LIQUIDS UNDER HIGH PRESSURE Patent**
Allan J. Zuckerwar, inventor (to NASA) and David S. Mazel, inventor (to NASA) (Old Dominion Univ., Norfolk, Va.) 13 Sep. 1988 8 p Filed 13 Feb. 1986 Supersedes N86-32700 (24 - 24, p 3729)
(NASA-Case-LAR-13300-1-CU; US-Patent-4,770,038; US-Patent-Appl-SN-829042; US-Patent-Class-73-290-V; US-Patent-Class-310-338; US-Patent-Class-367-908) Avail: US Patent and Trademark Office CSCL 14B

The invention relates to an ultrasonic depth gauge for liquids under high pressure and is particularly useful in the space industry where it is necessary to use a pressurized gas to transfer a liquid from one location to another. Conventional liquid depth gauges do not have the capability to operate under extreme high pressure (i.e., exceeding 300 psi). An ultrasonic depth gauge capable of withstanding high pressure according to the present invention is comprised of a transducer assembly and a supporting electronics unit. The former is mounted in to the bottom wall of a storage vessel with its resonating surface directly exposed to the highly pressurized liquid in the vessel. In operation, the ultrasonic pulse propagates upward through the liquid to the liquid-gas interface in the storage vessel. When the ultrasonic echo returns from the liquid-gas interface, it re-excites the composite resonator into vibration. The supporting electronics unit measures the round-trip transmit time for the ultrasonic pulse and its return echo to traverse the depth of the highly pressurized liquid. The novelty of the invention resides in the use of a conventional transducer rigidly bonded to the inside wall of a bored out conventional high-pressure plug to form a composite resonator capable of withstanding extremely high pressure.
Official Gazette of the U.S. Patent and Trademark Office

**N89-14408*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**CIRCUMFERENTIAL PRESSURE PROBE Patent Application**
Harlan K. Holmes, inventor (to NASA), Thomas C. Moore, inventor (to NASA), and Andrew J. Fanti, inventor (to NASA) 23 Sep. 1988 13 p
(NASA-Case-LAR-13775-1; NAS 1.71:LAR-13775-1; US-Patent-Appl-SN-248020) Avail: NTIS HC A03/MF A01 CSCL 14B

A probe for measuring circumferential pressure inside a body cavity is disclosed. In the preferred embodiment, a urodynamic pressure measurement probe for evaluating human urinary sphincter function is disclosed. Along the length of the probe are disposed a multiplicity of deformable wall sensors which typically comprise support tube sections with flexible side wall areas. These are arranged along the length of the probe in two areas, one just proximal to the tip for the sensing of fluid pressure inside the bladder, and five in the sensing section which is positioned within the urethra at the point at which the urinary sphincter constricts to control the flow of urine. The remainder of the length of the probe comprises multiple rigid support tube sections interspersed with flexible support tube sections in the form of bellows to provide flexibility. NASA

**N89-14409#** California Univ., Berkeley. Lawrence Berkeley Lab. Center for X-Ray Optics.
**PROGRESS AND PROSPECTS IN SOFT X-RAY HOLOGRAPHIC MICROSCOPY**
M. R. Howells, C. Jacobsen, J. Kirz, K. McQuaid, and S. S. Rothman (California Univ., San Francisco.) Dec. 1987 19 p Presented at the British Biophysical Society Conference on Modern Microscopies, Chester, United Kingdom, 20 Dec. 1987
(Contracts DE-AC03-76SF-00098; DE-AC02-76CH-00016)
(DE88-016638; LBL-25576; CONF-8712108-1) Avail: NTIS HC A03/MF A01

We report some of the latest developments in X-ray holography experiments and make some speculations about the limits of performance of the approaches currently in use. We also make some suggestions about where the technique can (and cannot) go in the future. DOE

**N89-14410#** Lawrence Livermore National Lab., CA.
**APPLICATION OF FABRY-PEROT VELOCIMETER TO HIGH-SPEED EXPERIMENTS**
H. H. Chau, C. F. McMillan, and J. E. Osher 1 Aug. 1988 7 p Presented at the 18th International Congress on High-speed

Photography and Photonics, Xian, China, 228 Aug. - 2 Sep. 1988
(Contract W-7405-eng-48)
(DE88-016269; UCRL-98483; CONF-8808103-3) Avail: NTIS
HC A02/MF A01

The Fabry-Rerot (F-P) velocimeter is a useful instrument for measuring the velocity of objects at speeds ranging from fractions of a km/sec to a few tens of km/sec and up. Because of its immunity to electromagnetic interference and its velocity resolution, it has become the prime diagnostic tool in our electric-gun facility. Examples of its application to high-speed experiments include the following areas: Electric-gun flyer studies; Spallation of materials under high-speed impact; Momentum-transfer studies; Pressure pulse created by high-velocity impact; Detonation-wave studies in high-explosive experiments. The F-P velocimeter at Lawrence Livermore National Laboratory includes a long-pulse laser amplifier, two-channel recording capability, air or fiber-optic transport of laser light, light enhancement through the F-P proper, and an electronic streaking camera with microchannel-plate intensifier. Data reduction includes a digitizing system that employs a video camera and a personal computer for manipulating fringe curves and calculating velocities. Software corrects distortions from the streak camera used to generate the record. The system yields a velocity measurement with an accuracy of 1 to 2 percent. DOE

**N89-14411#** Lawrence Livermore National Lab., CA.
**HIGH-SPEED MICROPHOTOGRAPHIC LABORATORY**
Alan M. Frank 19 Aug. 1988 13 p Presented at the 18th International Congress on High-Speed Photography and Photonics, Xian, China, 28 Aug. 1988
(Contract W-7405-eng-48)
(DE88-017009; UCRL-98498; CONF-8808103-4) Avail: NTIS
HC A03/MF A01

Lawrence Livermore National Laboratory's (LLNL's) High-Speed Microphotographic Laboratory provides a facility for studying rapidly evolving microstructures. In particular, the exploding of wires and foils and their interactions with high explosives are of particular interest. The facility combines high-speed electronic framing and streak cameras with the appropriate specialized optics, spectrographs, and laser illumination to record events with a few nanoseconds and micrometers of temporal and spatial resolutions, respectively. Velocity and spectral data are also used to compute pressures with better than kilobar resolution. DOE

**N89-14412#** Sandia National Labs., Albuquerque, N. Mex.
**DEVELOPMENT OF STRAIN GAGE EVALUATION CHANNELS**
W. L. Uncapher, D. R. Bronowski, and D. R. Stenberg 1988 6 p Presented at the Experimental Mechanics in Manufacturing and Quality Control, Indianapolis, IN, 6 Nov. 1988
(Contract DE-AC04-76DP-00789)
(DE88-017350; SAND-88-2340C; TTC-0828; CONF-881174-2)
Avail: NTIS HC A02/MF A01

The Transportation System Development Department at Sandia National Laboratories (SNL) evaluates the structural response of casks being developed to transport radioactive materials. A major part of this activity includes gathering instrumentation data from dynamic impact tests of cask models. These test are performed per the requirements defined in the Code of Federal Regulations 10 CFR 71.73, which includes a 9-m (30-ft) impact onto a flat, unyielding target and a 1-m (40-in.) puncture test onto a 15-cm (6-in.) in diameter puncture probe. The acquisition of reliable, high quality data is an important component of cask certification. One method to estimate the reliability of instrumentation during impact testing is to include evaluation channels for the various transducers (e.g., accelerometers, strain gages) used for measuring the cask structural response. Some accelerometer manufacturers have produced evaluation channels for use in the structural testing of casks. These commercial devices produce very low output, or no output, to applied shock acceleration. There are no commercially available packaged strain gage evaluation channels, however. Consequently, SNL has developed strain gage evaluation channels to estimate unwanted non-strain induced resistance changes that could affect resistance strain measurement data. DOE

**N89-14413#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
**CRYOGENIC THERMOMETERS BASED ON TVO TYPE RESISTORS AND THEIR APPLICATION**
V. I. Datskov, L. V. Petrova, and G. P. Tsvineva 1987 12 p In RUSSIAN; ENGLISH summary
(DE88-703755; JINR-R-8-87-604) Avail: NTIS (US Sales Only)
HC A03/MF A01

Results of a study of the characteristics of cryogenic thermometers based on TWO-0.125 resistors (R sub H = 1 k ohm) are presented. At a temperature of 4.2 K the repetition of values during 7 years is no worse than 0.015 K (approx. 0.4 percent), the sensitivity of some samples is from 570 omega/K to 1600 omega/K, the error in a magnetic field of 6 T is greater than 1 percent, the error after the radiation by 10 sup 17 n/sq cm fast neutrons is less than 1 percent, the heat capacity is approx. 1x3x10 sup -4 J/g.K, and the thermal inertia is approx. 1 ms. Some interpolation formulae are presented. Recommendations on the application of the cryogenic thermometers in setups are given. DOE

**N89-14414#** Air Force Geophysics Lab., Hanscom AFB, MA.
**POSSIBLE MEASUREMENT ERRORS IN CALIBRATED AVHRR (ADVANCED VERY HIGH RESOLUTION RADIOMETER) DATA Environmental Research Papers, 1987 - 1988**
Robert P. DEntremont and Thomas J. Kleespies 1 Apr. 1988 27 p
(AD-A198342; AFGL-TR-88-0105; AFGL-ERP-1001) Avail: NTIS
HC A03/MF A01 CSCL 04A

Visible and infrared meteorological satellite data are a primary source of global cloud observations. Such data are calibrated in order to provide its users with a method for converting from raw measurements, called counts, to physically sensible measurements such as albedo or brightness temperature. This report describes the procedure for converting National Oceanic and Atmospheric Administration Advanced Very High Resolution Radiometer (NOAA AVHRR) raw counts to albedos and brightness temperatures. This procedure involves the use of calibration coefficients that help define the relationship between the raw counts and the physical measurements they represent. Such relationships are referred to as look-up-tables. In theory, calibration coefficients (and therefore look-up tables) do not change noticeably from one scanline of satellite data to the next. This makes feasible the generation of a constant look-up table that can be used over long periods of time for all data. In practice, calibration coefficients can and often do change from one scan to the next. These changes imply accuracy errors in measured brightness temperatures that are significant for some satellite data analysis algorithms; others are less severely affected. This report addresses the potential errors that can be expected when using constant look-up tables, i.e., by assuming that sensor calibration does not change from one scanline to the next. GRA

**N89-14415#** Illinois Univ., Urbana. Laser Aided Materials Processing Lab.
**THERMAL ANALYSIS SYSTEM (DSC, TGA, TMA) FOR OXIDATION AND PHASE TRANSFORMATION STUDIES OF ALLOYS WITH MESTABLE PHASE Final Report, 1 Oct. 1986 - 30 Nov. 1987**
J. Mazumder, A. Kar, S. Sircar, C. Ribaudo, and R. Subramanian Jun. 1988 16 p
(Grant AF-AFOSR-0022-87; AF Proj. 2917)
(AD-A198420; AFOSR-88-0849TR) Avail: NTIS HC A03/MF
A01 CSCL 14B

The Perkin Elmer Thermal Analysis System Consists of various individual units like the Differential Thermal Analyzer (DTA), Differential Scanning Calorimeter (DSC), Thermogravimetric Analyzer (TGA) and the Thermomechanical Analyzer (TMA). Two controllers, two dedicated computers, one graphics plotter and one microbalance make up the entire package. The system was installed in November 1986 and was first put into operation the early part of 1987. GRA

**N89-14416*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**AUTOMATED DATA ACQUISITION AND PROCESSING FOR A HOHLRAUM REFLECTOMETER**
Frank DiFilippo (Case Western Reserve Univ., Cleveland, OH.) and Michael J. Mirtich Dec. 1988 8 p
(NASA-TM-101393; E-4466; NAS 1.15:101393) Avail: NTIS HC A02/MF A01 CSCL 14B

A computer and data acquisition board were used to automate a Perkin-Elmer Model 13 spectrophotometer with a Hohlraum reflectivity attachment. Additional electronic circuitry was necessary for amplification, filtering, and debouncing. The computer was programmed to calculate spectral emittance from 1.7 to 14.7 micrometers and also total emittance versus temperature. Automation of the Hohlraum reflectometer reduced the time required to determine total emittance versus temperature from about three hours to about 40 minutes. Author

**N89-14417*#** Alabama Univ., Huntsville. Civil Engineering Program.
**DEVELOPMENT OF AN ENDOSCOPIC PROBE FOR RADIAL METROLOGY Final Report**
John A. Gilbert and James E. Smith, Jr. 28 Nov. 1988 35 p (Grant NAG8-686)
(NASA-CR-184577; NAS 1.26:184577; UAH-750) Avail: NTIS HC A03/MF A01 CSCL 14B

The goal of this work was to design and build a prototype for conducting stress analysis and making spectroscopic measurements inside cavities. The objectives were as follows: (1) to develop a prototype for radial profilometry; (2) to explore the possibility of using the radial profilometer for spectroscopic analysis; and (3) to interface the prototype with various combinations of data acquisition and image processing equipment. Author

**N89-14418*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**HEAT FLUX MEASUREMENTS**
Curt H. Liebert and Donald H. Weikle 1989 14 p Proposed for presentation at the 34th International Gas Turbine and Aeroengine Congress and Exposition, Toronto, Ontario, 4-8 Jun. 1989; sponsored by ASME
(NASA-TM-101428; E-4530; NAS 1.15:101428) Avail: NTIS HC A03/MF A01 CSCL 14B

A new automated, computer controlled heat flux measurement facility is described. Continuous transient and steady-state surface heat flux values varying from about 0.3 to 6 MW/sq m over a temperature range of 100 to 1200 K can be obtained in the facility. An application of this facility is the development of heat flux gauges for continuous fast transient surface heat flux measurement on turbine blades operating in space shuttle main engine turbopumps. The facility is useful for durability testing at fast temperature transients. Author

**N89-14419#** Technische Hogeschool, Delft (Netherlands).
**AUTOMATION OF A GUINIER CAMERA FOR X-RAY DIFFRACTION Ph.D. Thesis**
Jozef Henricus Duijn 1988 82 p
(ETN-89-93350) Avail: NTIS HC A05/MF A01

A Guinie camera was equipped with a curved proportional counter to allow fast recording of diffraction patterns. The focusing principles are discussed and the optimum dimensions of the proportional counter are determined. Measurements on a counter prototype are discussed. A simplified readout method is introduced. In order to reconstruct the position of absorption of an incident X-ray, the charge distribution on the cathode strips of the counter is measured. The results are compared with computed charge distributions. A protocol which corrects the systematic errors introduced by the charge ratio reconstruction method is presented. ESA

**N89-14420** Technische Hogeschool, Delft (Netherlands).
**QUANTITATIVE HOLOGRAPHIC INTERFEROMETRY: MEASUREMENT OF SOLID OBJECT DEFORMATIONS Ph.D. Thesis**
Rudolf Francois Corn Kriens 1988 273 p
(ETN-89-93351) Copyright Avail: Rudolf Kriens, Fokker Aircraft Co., P.O. Box 7600, 1117 ZJ Schiphol, The Netherlands

The formal theory, design considerations and development of an industrial holographic interferometer system are presented. The system is designed for industrial practice where it has to accommodate large objects (1 m typical dimension) having highly irregular or unknown shapes. The device must carry out accurate quantitative measurements of vectorial deformation fields or rigid body motions. Numerical algorithms were developed fulfilling all design requirements. Various experiments are described which demonstrate the capabilities of the system for measurement of vectorial deformations. ESA

**N89-14421*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**MAGNETIC AND ELECTRIC FIELD METERS DEVELOPED FOR THE US DEPARTMENT OF ENERGY**
H. Kirkham and A. Johnson Jan. 1988 129 p Sponsored by NASA
(NASA-CR-184628; NAS 1.26:184628; JPL-Publ-88-1; DOE/ET-29372/8) Avail: NTIS HC A07/MF A01 CSCL 14B

This report describes work done at the Jet Propulsion Laboratory for the Office of Energy Storage and Distribution of DOE on the measurement of power line fields. A magnetic field meter is discussed that uses fiber optics to couple a small measuring probe to a remote readout device. The use of fiber optics minimizes electric field perturbation due to the presence of the probe and provides electric isolation for the probe, so that it could be used in a high field or high voltage environment. Power to operate the sensor electronics is transferred via an optical fiber, and converted to electrical form by a small photodiode array. The fundamental, the second and third harmonics of the field are filtered and separately measured, as well as the broadband rms level of the field. The design of the meter is described in detail and data from laboratory tests are presented. The report also describes work done to improve the performance of a DC bushing in a Swedish factory, using the improved meter. The DC electric fields are measured with synchronous detection to provide field magnitude data in two component directions. Author

**N89-14422*** National Aeronautics and Space Administration. Pasadena Office, CA.
**CONTROLLED SAMPLE ORIENTATION AND ROTATION IN AN ACOUSTIC LEVITATOR Patent**
Martin B. Barmatz, inventor (to NASA), Mark S. Gaspar, inventor (to NASA), and Eugene H. Trinh, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 18 Oct. 1988 9 p
(NASA-Case-NPO-17086-1-CU; US-Patent-4,777,823; US-Patent-Appl-SN-087359; US-Patent-Class-73-505) Avail: U.S. Patent and Trademark Office CSCL 14B

A system is described for use with acoustic levitators, which can prevent rotation of a levitated object or control its orientation and/or rotation. The acoustic field is made nonsymmetrical about the axis of the levitator, to produce an orienting torque that resists sample rotation. In one system, a perturbating reflector is located on one side of the axis of the levitator, at a location near the levitated object. In another system, the main reflector surface towards which incoming acoustic waves are directed is nonsymmetrically curved about the axis of the levitator. The levitated object can be reoriented or rotated in a controlled manner by repositioning the reflector producing the nonsymmetry.
Official Gazette of the U.S. Patent and Trademark Office

**N89-14423*** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**PRESSURE MEASURING PROBE Patent**
George C. Ashby, Jr., inventor (to NASA) 15 Nov. 1988 5 p Filed 13 Jan. 1988 Supersedes N88-23961 (26 - 17, p 2341)

(NASA-Case-LAR-13853-1; US-Patent-4,783,994; US-Patent-Appl-SN-143436; US-Patent-Class-73-147; US-Patent-Class-73-861.65) Avail: U.S. Patent and Trademark Office CSCL 14B

The invention is a probe for measuring changes in pressure in a high velocity fluid stream over and adjacent to the surface of an object. The probe is formed of an exterior housing having a closed pressure chamber in which a piezoelectric pressure transducer is mounted. An open connector tube having a probe tip passes a portion of the fluid stream into the closed pressure chamber; any change of pressure within, which requires a settling-time to appear in the closed pressure chamber, is inversely proportional to the cross-sectional area of the connector tube. A cooling chamber formed around the pressure chamber is connected to a source of cooling fluid by means of inlet and outlet tubes.

Official Gazette of the U.S. Patent and Trademark Office

# 36 LASERS AND MASERS

Includes parametric amplifiers.

For related information see also *76 Solid-State Physics*.

**N89-14424#** National Bureau of Standards, Boulder, CO. Time and Frequency Div.

**INVESTIGATION OF THE HYDROGEN SOURCE FOR MASERS**

K. B. Persson and F. L. Walls Apr. 1988 58 p

(PB88-225685; NBS/TN-1315) Avail: NTIS HC A04/MF A01; also available SOD HC $2.75 as 003-003-02870-3 CSCL 20E

Various engineering and phenomenological aspects of the radio frequency discharge source for atomic hydrogen used in the masers have been investigated theoretically and experimentally to provide a base for minimizing the size of the source and its power consumption. A scheme and detector have been devised, permitting absolute detection of the atomic beam, and an atom-atom surface recombination theory was developed, applicable to the detector as well as to the walls of the discharge vessel. A self-starting radio frequency circuit, allowing as little as 0.1 W power consumption by the atom source, has been developed. GRA

**N89-14425** Columbia Univ., New York, NY.

**ELECTRON-BEAM-PUMPED SEMICONDUCTOR LASERS Ph.D. Thesis**

Franklin Fuk-Kay Tong 1987 245 p

Avail: Univ. Microfilms Order No. DA8809433

Electron-beam-pumped semiconductor laser arrays emitting high power visible radiation are developed and investigated. The 250 keV electron beam used as a pump source in these experiments is generated by an electron gun in 3.7 nsec pulses. A square array of 625 laser cavities, each with a 220 x 220 micron square cross section, was successfully fabricated on a 55 micron thick CdS wafer. Blue emitting ternary lasers, such as Zn(x)Cd(1-x)S and ZnS(x)Se(1-x), are also studied in both longitudinal and transverse pumping configurations. In order to establish the cavity parameters that minimize parasitic oscillation in laser arrays, single element lasers of various pump sizes and coupling reflectivities are studied. Several characteristics of the laser material, such as the internal quantum eficiency, are also extracted from the single element laser experiments. The laser cavities are fabricated on wafers displaying residual wedge angles of 0.001 to 0.0001 radians. Cavities formed on such a wafer are unstable. A simple geometric model of a wedge cavity is developed and accurately predicts the measured spatial and spectral characteristics of the laser array.

Dissert. Abstr.

**N89-14426*#** David Sarnoff Research Center, Princeton, NJ.

**HIGH-POWER AlGaAs CHANNELED SUBSTRATE PLANAR DIODE LASERS FOR SPACEBORNE COMMUNICATIONS Final Report, 4 Aug. 1986 - 15 Jul. 1987**

J. C. Connolly, B. Goldstein, G. N. Pultz, S. E. Slavin, D. B. Carlin, and M. Ettenberg Washington, DC Nov. 1988 168 p

(Contract NAS1-17441)

(NASA-CR-4189; NAS 1.26:4189) Avail: NTIS HC A08/MF A01 CSCL 20E

A high power channeled substrate planar AlGaAs diode laser with an emission wavelength of 8600 to 8800 A was developed. The optoelectronic behavior (power current, single spatial and spectral behavior, far field characteristics, modulation, and astigmatism properties) and results of computer modeling studies on the performance of the laser are discussed. Lifetest data on these devices at high output power levels is also included. In addition, a new type of channeled substrate planar laser utilizing a Bragg grating to stabilize the longitudinal mode was demonstrated. The fabrication procedures and optoelectronic properties of this new diode laser are described. Author

**N89-14427*#** Maryland Univ., College Park. Dept. of Electrical Engineering.

**INVESTIGATION OF RF EXCITED CW CO2 WAVEGUIDE LASERS LOCAL OSCILLATOR - RF EXCITATION Final Report**

U. Hochuli May 1988 24 p

(Grant NAG5-263)

(NASA-CR-183344; NAS 1.26:183344) Avail: NTIS HC A03/MF A01 CSCL 20E

A new local oscillator housing was built which seems to have improved laser life. Laser cooling was changed from internal water cooling to the more convenient thermal contact cooling. At the present time, a conclusion can not be made if the 20 percent reduction in power output is the result of poorer cooling or poorer grating alignment. The coupling-starting network was improved from 55 to about 90 percent. It can be adjusted by varying trimmers C sub 1 and C sub 2 to match RF power levels between 10 and 30 W. If the laser admittance changes greatly with laser life rematching will have to be achieved by remote control for space applications. The same holds true if the RF power level has to be changed with a maximum efficiency constraint. Author

**N89-14428*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**METHOD AND APPARATUS FOR REDUCING SPECKLE Patent Application**

Israel Taback, inventor (to NASA) (Bionetics Corp., Hampton, VA.) 19 Jul. 1988 12 p

(NASA-Case-LAR-13771-1; NAS 1.71:LAR-13771-1; US-Patent-Appl-SN-221387) Avail: NTIS HC A03/MF A01 CSCL 20E

The invention is a method and apparatus for reducing speckle in an unmodulated laser pulse of a known coherence length by introducing a number (N) of independent time delays (TD) into the input pulse equal to the shorter of the coherence length of the laser input pulse source or the width of the delayed laser output pulses to reduce speckle in the combined laser output pulses by the function of the number N of independent time delays (TD). NASA

**N89-14429#** Oak Ridge National Lab., Tenn. Chemical Physics Section.

**INFLUENCE OF THE A.C. STARK EFFECT ON STIMULATED HYPER-RAMAN PROFILES IN SODIUM VAPOR**

Mary Anne Moore, W. R. Garrett, and M. G. Payne Aug. 1988 4 p Presented at the 35th National Vacuum Symposium and 4th International Laser Science, Conference, Atlanta, GA, 2 Oct. 1988

(Contract DE-AC05-84OR-21400)

(DE88-015557; CONF-881002-2) Avail: NTIS HC A02/MF A01

When pumping near the two-photon 3d resonance in pure sodium vapor and observing the backward hyper-Raman emission to the 3p substates, an asymmetry in ratios of 3p(sub 1/2), 3p(sub 3/2) associated emissions was observed dependent upon the direction of the initial laser detuning from the resonance. It has been determined that this asymmetry can be attributed to the A.C. Stark effect induced by the hyper-Raman emission itself.

DOE

**N89-14430#** Los Alamos National Lab., NM.
**SUBPICOSECOND, HIGH-BRIGHTNESS EXCIMER LASER SYSTEMS**
A. J. Taylor, T. R. Gosnell, J. P. Roberts, C. S. Lester, R. B. Gibson, S. E. Harper, and C. R. Tallman 1988 4 p Presented at the International Conference on Ultrafast Phenomena '88, Kyoto, Japan, 12 Jul. 1988
(Contract W-7405-eng-36)
(DE88-016239; LA-UR-88-2569; CONF-8807105-1; CONF-8807106-1) Avail: NTIS HC A02/MF A01

Subpicosecond, high-brightness excimer laser systems are being used to explore the interaction of intense coherent ultraviolet radiation with matter. Applications of current systems include generation of picosecond X-ray pulses, investigation of possible X-ray laser pumping schemes, studies of multiphoton phenomena in atomic species, and time-resolved photochemistry. These systems, based on the amplification of subpicosecond pulses in small aperture (approximately 1 sq. cm.) XeCl or KrF amplifiers, deliver focal spot intensities of approximately 10 to the 17th power W/sq. cm. Scaling to higher intensities, however, will require an additional large aperture amplifier which preserves near-diffraction-limited beam quality and subpicosecond pulse duration. We describe here both a small aperture KrF system which routinely provides intensities greater than 10 to the 17th power W/sq. cm. to several experiments, and a large aperture XeCl system designed to deliver approximately 1 J subpicosecond pulses and yield intensities on target in excess of 10 to the 19th power w/sq.cm. We also discuss the effects of two-photon absorption on large-aperture, high-brightness excimer lasers. DOE

**N89-14431#** Purdue Univ., West Lafayette, Ind. Dept. of Chemistry.
**REACTIONS OF METAL IONS AND THEIR CLUSTERS IN THE GAS PHASE USING LASER IONIZATION-FOURIER TRANSFORM MASS SPECTROMETRY Progress Report, 1 Aug. 1987 - 31 Jan. 1989**
Ben S. Freiser Sep. 1988 6 p
(Contract DE-FG02-87ER-13766)
(DE88-017281; DOE/ER-13766/2) Avail: NTIS HC A02/MF A01

This past year has been another outstanding one for us, with progress made on a number of fronts. The thrust of our work continues to be the study of the chemistry and photochemistry of gas phase transition metal ions, metal-ligand ions, and small metal cluster ions using powerful Fourier transform mass spectrometric methods. This quarter, LaFe (2+) was synthesized. The bonding and the measurement of kinetic energy released during dissociation is briefly discussed. DOE

**N89-14432#** Argonne National Lab., IL. Physics Div.
**LASER-DRIVEN POLARIZED SOURCES OF HYDROGEN AND DEUTERIUM**
L. Young, R. J. Holt, M. C. Green, and R. S. Kowalczyk 1988 5 p Presented at the 1st European Workshop on Hadronic Physics in the 1990's With Multi-GeV Electrons, Seillac, France, 27 Jun. 1988
(Contract W-31-109-eng-38)
(DE89-000541; CONF-8806236-2) Avail: NTIS HC A02/MF A01

A novel laser-driven polarized source of hydrogen and deuterium which operates on the principle of spin exchange optical pumping is described. The advantages of this method over conventional polarized sources for internal target experiments are presented. Technological difficulties which prevent ideal source operation are outlined along with proposed solutions. At present, the laser-driven polarized hydrogen source delivers 8 times 10 to the 16th atoms/s with a polarization (P sub z) of 24 percent. DOE

**N89-14433#** California Univ., Riverside. Dept. of Electrical and Computer Engineering.
**ELECTRON ACCELERATION BY LASER FIELDS IN A GAS Progress Report**
J. R. Fontana 1 Oct. 1988 11 p
(Contract DE-AS03-84ER-40136)
(DE89-000567; DOE/ER-40136/T8) Avail: NTIS HC A03/MF A01

As specified in the proposal, part of the work concerned planning for the experimental tests that will become possible at the completion of the Accelerator Test Facility (ATF) now under construction at the Brookhaven National Laboratory (BNL), and the coordination of research with Spectra Technology, Inc. (STI) in Seattle. This activity is summarized here. In addition, work has proceeded on the theory of Inverse Cherenkov Acceleration by an analysis of how effective currently available lasers can be for acceleration; this also is discussed in this report. DOE

**N89-14434#** Rochester Univ., N. Y. Lab. for Laser Energetics.
**CHIRPED PULSE AMPLIFICATION: PRESENT AND FUTURE**
P. Maine, D. Strickland, M. Pessot, J. Squier, P. Bado, G. Mourou, and D. Harter 1988 6 p Prepared in cooperation with Allied-Signal, Inc., Morristown, NJ
(Contract DE-FC08-85DP-40200)
(DE89-001016; DOE/DP-40200/77) Avail: NTIS HC A02/MF A01

Short pulses with ultrahigh peak powers have been generated in Nd: glass and Alexandrite using the Chirped Pulse Amplification (CPA) technique. This technique has been successful in producing picosecond terawatt pulses with a table-top laser system. In the near future, CPA will be applied to large laser systems such as NOVA to produce petawatt pulses (1 kJ in a 1 ps pulse) with focused intensities exceeding 10 sup +21) W/sq cm. These pulses will be associated with electric fields in excess of 100 e/a sup 2 sub a and blackbody energy densities equivalent to 3 x 10 to the 10th J/cu cm. This petawatt source will have important applications in X-ray laser research and will lead to fundamentally new experiments in atomic, nuclear, solid-state, plasma, and high-energy density physics. A review of present and future designs is discussed. DOE

**N89-14435#** Illinois Univ., Chicago. Dept. of Physics.
**STUDY OF EXTREME ULTRAVIOLET LASER SOURCES FOR THE GUIDING OF PARTICLE BEAMS**
Charles K. Rhodes, Keith Boyer, and Ting Shan Luk 31 Jul. 1987 111 p Prepared for LLNL, CA
(Contract W-7405-eng-48)
(DE88-008918; UCRL-21028) Avail: NTIS HC A06/MF A01

Spectrally bright femtosecond sources of short wavelength radiation can be applied to guide particle beams and possibly enable the collective acceleration of electrons. An effort directed at the development of extremely high peak power ultraviolet sources in the range of approximately 10 TW is proposed. DOE

**N89-14436#** Lawrence Livermore National Lab., CA.
**THE ELECTRON LASER FACILITY: A MILLIMETER WAVE FREE-ELECTRON LASER AMPLIFIER**
T. J. Orzechowski 15 Jul. 1988 16 p Presented at the Free Electron Laser Seminar, Beijing, China, 11 Aug. 1988
(Contract W-7405-eng-48)
(DE88-016118; UCRL-99180; CONF-880888-10) Avail: NTIS HC A03/MF A01

The Electron Laser Facility (ELF) is a free-electron laser amplifier operating in the millimeter-wave regime. We have demonstrated exponential gain, saturation, and tapering the wiggler to prevent saturation. The results of this experiment are in excellent agreement with theory and simulation. DOE

**N89-14437#** Sandia National Labs., Albuquerque, N. Mex.
**HIGH-ENERGY UV LASER EXPERIMENTS**
R. G. Adams, C. A. Frost, B. F. Clark, J. M. Jojola, D. A. Dew, J. Leija, and M. M. Dillon 1988 7 p Presented at the DARPA/SDIO Services Annual Propagation Review, Newport, RI, 12 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE89-000505; SAND-88-2507C; CONF-8809149-1) Avail: NTIS HC A02/MF A01

A pulsed, high-energy (greater than 5 J) KrF ultraviolet laser

system has been developed and used in initial conditioning cell experiments with the IBEX 4-MV electron beam accelerator. High currents (35 kA) have been efficiently and stably transported in a 1-cm-diameter beam through low-pressure diethylaniline (DEA) vapor. Conditioning cell details, laser-accelerator parameters, and initial transport results are discussed. DOE

**N89-14438#** Naval Research Lab., Washington, DC.
**HANEX SIMULATIONS OF LASER-TARGET INTERACTIONS: 1. RADIATION PROCESSES**
John L. Giulliani, Jr., Margaret Mulbradon, and Ellis Hyman 8 Jun. 1988 38 p
(AD-A197965; NRL-MR-6223) Avail: NTIS HC A03/MF A01 CSCL 17E

Numerical simulations of the laser-target interaction and subsequent plasma blowoff expansion for the PHAROS 3 experiment are presented using the HANEX code. This report emphasize the properties of the radiation field and the photo-absorption physics in the background gas. The multi-frequency radiation transport technique employed in HANEX is fully described. Likewise, the phenomenological treatment in HANEX for the ionization, dissociation, and heating in the background gas resulting from radiation deposition is presented. The evolution of the background due to radiation deposition is studied from the time of the peak of the laser pulse to 60 nsec later. Model spectra of the heated plasma blowoff predict strong emission lines from highly ionized nitrogen and aluminum in the cavity. GRA

**N89-14439#** Naval Research Lab., Washington, DC. Plasma Physics Div.
**STOCHASTIC ELECTRON DETRAPPING IN FELs (FREE ELECTRON LASERS) CAUSED BY SIDEBANDS**
S. Riyopoulos (Science Applications International Corp., McLean, Va.) and C. M. Tang 14 Jul. 1988 50 p
(AD-A198361; NRL-MR-6224) Avail: NTIS HC A03/MF A01 CSCL 09C

The growth of sidebands in a free electron laser (FEL) above a certain threshold will result in stochastic electron motion. This may lead to significant electron detrapping and loss of amplification for the radiation field. The threshold in the sideband amplitude for the stochastic transition is computed. The rate trapped electrons leak outside the sepratrix is measured by the diffusion coefficient in action space. This approach is general and covers both tapered and untapered wigglers. Three general types of spectra are examined: a narrow, a broad discrete and a broad continuous. Each type is associated with a particular scaling of the diffusion coefficient on the FEL parameters. Numerical results, obtained for constant radiation amplitudes, show good agreement with the theoretical predictions. This diffusion rate is always proportional to the total sideband-to-carrier power ratio, with different coefficients of proportionality for each spectral type. The narrow types of spectrum causes the highest diffusion rates and the broad continuous spectrum causes the lowest diffusion rates under constant total sideband power. The diffusion length, measured in wiggler periods, is independent of the beam energy gamma. Serious deterioration in the FEL efficiency will result when the diffusion length becomes shorter than the wiggler length. GRA

**N89-14440#** Hughes Research Labs., Malibu, CA.
**IONIZATION RATES RELEVANT TO LASER COOLING OF HYDROGEN Final Report, 1 Aug. 1987 - 31 Jan. 1988**
R. S. Turley Jun. 1988 51 p
(Contract F49620-87-C-0083)
(AD-A198481; AFOSR-88-0833TR) Avail: NTIS HC A04/MF A01 CSCL 07E

Laser cooling of atomic hydrogen has practical importance is a wide variety of applications ranging from relativistic neutral particle beam weapons to atomic clocks and exotic fuels. A laser beam suitable for atomic hydrogen cooling needs to be high intensity, narrowband, coherent, and broadly tunable in the region around Lyman-alpha (1216 A). We have produced a source meeting these criteria. We studied, characterized, and optimized this source for conditions important to laser cooling. In this introductory section, we will discuss the physics and potential practical applications of laser cooling and tunable VUV sources. These will be followed by an introduction to the specific results obtained during the six months of this contract. GRA

**N89-14441#** Naval Postgraduate School, Monterey, CA.
**SEMICONDUCTOR LASER DIODES AND THE DESIGN OF A D.C. POWERED LASER DIODE DRIVE UNIT M.S. Thesis**
Joseph C. Cappuccio, Jr. Jun. 1988 93 p
(AD-A198556) Avail: NTIS HC A05/MF A01 CSCL 09C

This thesis addresses the design, development and operational analysis of a D.C. powered semiconductor laser diode drive unit. A laser diode requires an extremely stable power supply since a picosecond spike of current or power supply switching transient could result in permanent damage. The design offers stability and various features for operational protection of the laser diode. The ability to intensity modulate (analog) and pulse modulate (digital) the laser diode output for data transmission was a major design consideration. Laser optical power is controlled via a closed loop system using a monitor photodiode. Laser diode temperature stabilization is accomplished with the use of a thermoelectric cooler. Laboratory and remote applications were considered in the design of this unit. GRA

**N89-14915*#** Elizabeth City State Univ., NC. Dept. of Physical Sciences.
**THE DETERMINATION OF ENERGY TRANSFER RATES IN THE Ho:Tm:Cr:YAG LASER MATERIAL Abstract Only**
Edmond B. Koker *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 75-77 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20E

# 37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

**N89-14442** Council for National Academic Awards (England).
**AN INVESTIGATION INTO FLUID FILM LUBRICATION IN DYNAMICALLY LOADED BEARINGS Ph.D. Thesis**
Atil Paydas 1988 544 p
Avail: Univ. Microfilms Order No. BRDX81307

A numerical technique for the computational analysis of ruptured liquid films in both steadily and dynamically loaded bearings was developed. The approach is based on the principle of oil flow continuity. A cavitation algorithm, proposed by H. G. Elrod, was implemented for studies of hydrodynamic lubrication in infinitely long cylinder/plane bearings under combined sliding, rolling, and normal motion. Difficulties involved in the implementation of this algorithm were investigated in great depth. An improved method of solution, which is well-suited to the computational analyses of steadily and dynamically loaded bearings, was developed. The improved technique involves the solution of the hydrodynamic lubrication problem for oil film pressures or degrees of lubricant filling in the full film and cavitated regions of a bearing. Detailed studies of cylinder/plane under conditions of both instantaneous and sinusoidal normal motion were performed. Computer programs based on the classical Reynolds equation and the improved method of solution were developed for the analysis of circumferentially grooved, finite journal bearing operating under steady state and dynamic loading conditions. Comprehensive comparisons with published theoretical and experimental studies were made. Dissert. Abstr.

**N89-14443** Sussex Univ., Brighton (England).
**IDENTIFICATION OF DYNAMIC PARAMETERS OF A SQUEEZE-FILM BEARING Ph.D. Thesis**

Mohamed Dahalan Moha Ramli 1987 399 p
Avail: Univ. Microfilms Order No. BRDX81088

Three experimental methods for identifying the direct fluid dynamic parameters of a squeeze-film damper are presented. The corresponding direct fluid dynamic coefficients are evaluated from the identified parameters. Before applying the identification techniques to experimental data, they are tested on simulated data and are shown to be accurate and efficient. The first, a transient method, involves applying parametric identification and optimization to sequentially digitized, free-decay experimental data for the purpose of estimating damping and stiffness parameters. The second method is a time domain forced vibration technique (TDT). This involves identification of damping, inertia, and stiffness; parameters from experimental, sequential, digitized displacement, and force data obtained from two equal amplitude sinusoidal forcing inputs. The third method is a frequency domain forced vibration technique (FDT). The three parameters are estimated by a linear least square regression performed on points obtained from the in and out of phase information of sequential digitized displacement and force data at different sinusoidal forcing frequencies.
Dissert. Abstr.

**N89-14444#** Battelle Columbus Labs., OH.
**DEVELOPMENT OF A ROTARY VALVE FOR PULSE COMBUSTION APPLICATIONS Annual Report, Jun. 1986 - Jun. 1987**
Paul E. George and John M. Corliss 5 Oct. 1988 55 p
(Contract GRI-5086-234-1280)
(PB88-250568; GRI-87/0279) Avail: NTIS HC A04/MF A01 CSCL 13K

Development of a rotary valve air inlet for pulse conbustor systems in a variety of industrial applications is reviewed. The work focuses on development of a rotary valve pulse combustor that will operate at input rates of up to 100,000 Btu/hr with computer control capable of synchronizing a motor-driven valve to combustor pressure oscillations. Activities included integrating the valve and combustor, conducting baseline experiments, developing computer control, integrating components, and performing laboratory evaluation. GRA

**N89-14445#** Los Alamos National Lab., NM.
**EXPERIMENTS WITH THREE IDENTICAL ULTRAPRECISION MACHINE TOOLS**
Chris Evans (Wisconsin Univ., Madison.), Phil Hannah, and Richard Rhorer 1988 24 p Presented at the Conference on Advances in Optical Fabrication and Metrology, San Diego, CA, 14 Aug. 1988 Prepared in cooperation with NBS, Washington, DC
(Contract W-7405-eng-36)
(DE88-016324; LA-UR-88-2688; CONF-8808120-1) Avail: NTIS HC A03/MF A01

This paper outlines the underlying philosophy of, and reports preliminary results from, experiments with three nominally identical diamond turning machines. Identical tools, specially fabricated from the same diamond, were used to machine mirrors from blanks cut from the same base material using previously specified process parameters. Parts produced are compared. DOE

**N89-14446#** Oak Ridge National Lab., Tenn. Engineering Physics and Mathematics Div.
**DESIGN OF AN OBSTACLE AVOIDANCE SYSTEM FOR AIMS**
David B. Reister and Mark W. Noakes 1988 9 p Presented at Advances in Intelligent Robotics Systems, Cambridge, MA, 6 Nov. 1988
(Contract DE-AC05-84OR-21400)
(DE88-016783; CONF-881116-2) Avail: NTIS HC A02/MF A01

The Advanced Integrated Maintenance System (AIMS) is a remote maintenance system that uses a dual-arm teleoperator to control the Advanced Servomanipulator (ASM). Although, the ASM was designed for nuclear fuel reprocessing, it can provide a testbed for space telerobotics (space servicing and assembly). The objective of this project is to design and implement a generalized capability for automatic path-planning and obstacle avoidance during motion of the manipulator transporter (overhead crane and main manipulator shaft) from one work location in the hotcell to another. The work is to be accomplished in two phases. In the first phase, the transporter will move in a known world. In the second phase, sensor data will be used to update and verify the world model and the system will have the capability to avoid unexpected obstacles. This paper describes the design and initial development of a system for phase one. DOE

**N89-14447#** North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
**THE ROLE OF THERMOELASTIC EFFECTS IN THE SCUFFING FAILURE OF ROLLING/SLIDING EHD CONTACTS Final Report**
R. R. Johnson and T. A. Dow 15 Aug. 1988 65 p
(Contract N00014-82-K-0551)
(AD-A198475) Avail: NTIS HC A04/MF A01 CSCL 20K

A two-dimensional numerical solution of the thermal Reynolds', elasticity, and energy equations resulted in predictions of the flow velocities and temperatures within the lubricant film between a crown roller and a rotating shaft. The results showed a good agreement with previously measured experimental data on the surface temperatures in an EHD contact and on the resulting frictional torques for both rolling and sliding. A pressure and temperature dependent viscosity was assumed for the synthetic paraffinic hydrocarbon used in the experiments. This model allowed an evaluation of the relative importance of the generation, viscous dissipation, and compression terms in the energy equation at different stations along the mid-film line of contact. Based on the insight about the relative importance of terms as found in the numerical simulation, convenient expressions were developed for an approximate method of predicting the mid-film temperature and sliding friction force. The influence of thermal expansion of the contact between a crowned surface in sliding contact with a rotating cylindrical surface was included in a model of thermoelastic instability to predict the onset of scuffing failure. The simplified approach assumed a heat balance between the generation from friction and the heat conducted into the cylinders. GRA

**N89-14448#** Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
**LIGHT WEIGHT HIGH PERFORMANCE MANIPULATORS Final Report, 1 Apr. 1985 - 31 Mar. 1988**
Roger W. Brockett 25 Jul. 1988 19 p
(Contract DAAG29-85-K-0096)
(AD-A198647; ARO-22332.1-MA) Avail: NTIS HC A03/MF A01 CSCL 20C

In this work we explored the design of high strength low weight actuators based on vibratory kinematics. We developed a mathematical model for a linear motor based on standing wave vibrations and built versions of such devices using both magnetostrictive and electromagnetic actuators. Our analysis and our implementations show that such devices can be made to work. We include in this report suggestions as to how to further enhance the performance of this type of system. GRA

**N89-14449*#** Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
**DYNAMIC ANALYSIS OF NONLINEAR ROTOR-HOUSING SYSTEMS**
Sherif T. Noah Oct. 1988 89 p
(Contract NAS8-36293)
(NASA-CR-184611; NAS 1.26:184611) Avail: NTIS HC A05/MF A01 CSCL 13I

Nonlinear analysis methods are developed which will enable the reliable prediction of the dynamic behavior of the space shuttle main engine (SSME) turbopumps in the presence of bearing clearances and other local nonlinearities. A computationally efficient convolution method, based on discretized Duhamel and transition matrix integral formulations, is developed for the transient analysis. In the formulation, the coupling forces due to the nonlinearities are treated as external forces acting on the coupled subsystems. Iteration is utilized to determine their magnitudes at each time increment. The method is applied to a nonlinear generic model of

the high pressure oxygen turbopump (HPOTP). As compared to the fourth order Runge-Kutta numerical integration methods, the convolution approach proved to be more accurate and more highly efficient. For determining the nonlinear, steady-state periodic responses, an incremental harmonic balance method was also developed. The method was successfully used to determine dominantly harmonic and subharmonic responses fo the HPOTP generic model with bearing clearances. A reduction method similar to the impedance formulation utilized with linear systems is used to reduce the housing-rotor models to their coordinates at the bearing clearances. Recommendations are included for further development of the method, for extending the analysis to aperiodic and chaotic regimes and for conducting critical parameteric studies of the nonlinear response of the current SSME turbopumps.
Author

**N89-14450*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**IMPROVEMENT IN FINITE ELEMENT MESHES: HEAT TRANSFER IN AN INFINITE CYLINDER**
Madan G. Kittur, Ronald L. Huston (Cincinnati Univ., OH.), and Fred B. Oswald Dec. 1988 15 p Prepared in cooperation with Army Aviation Research and Development Command, Cleveland, Ohio
(Grants NsG-3188; DA-1L1-62209-A-47-A)
(NASA-TM-101410; E-4226; NAS 1.15:101410;
AVSCOM-TR-88-C-021) Avail: NTIS HC A03/MF A01 CSCL 20M

An extension of a structural finite element mesh improvement technique to heat conduction analysis is presented. The mesh improvement concept was originally presented by Prager in studying tapered, axially loaded bars. It was further shown that an improved mesh can be obtained by minimizing the trace of the stiffness matrix. These procedures are extended and applied to the analysis of heat conduction in an infinitely long hollow circular cylinder.
Author

**N89-14451#** Universite de Technologie de Compiegne (France).
**SYSTEM FOR THE OPTIMUM DESIGN OF STRUCTURES Final Report [SYSTEME DE CONCEPTION OPTIMALE DES STRUCTURES]**
C. Knopf-Lenoir Dec. 1987 162 p In FRENCH
(Contracts DRET-80-578; DRET-82-355)
(ETN-89-93599) Avail: NTIS HC A08/MF A01

Development of an interactive procedure to treat and optimize the contour shape of plane mechanical elements in a finite element model is presented. The modifications include the use of a graphic screen for the visualization of the interactive results, a reduction of the initial data set necessary to the definition of the objects, graphic functions for post processing of results, and the possibility to link optmization stages belonging to the same initial problem.
ESA

**N89-14452*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**THE ROLE OF THERMAL AND LUBRICANT BOUNDARY LAYERS IN THE TRANSIENT THERMAL ANALYSIS OF SPUR GEARS**
L. E. El-Bayoumy, L. S. Akin, D. P. Townsend, and F. C. Choy (Akron Univ., OH.) 1989 17 p Proposed for presentation at the 5th International Power Transmission and Gearing Conference, Chicago, IL, 25-27 Apr. 1989; sponsored by ASME Prepared in cooperation with Army Aviation Research and Development Command, Cleveland, OH
(DA Proj. 1L1-62209-A-47-A)
(NASA-TM-101435; E-4413; NAS 1.15:101435;
AVSCOM-TR-88-C-032) Avail: NTIS HC A03/MF A01 CSCL 13I

An improved convection heat-transfer model has been developed for the prediction of the transient tooth surface temperature of spur gears. The dissipative quality of the lubricating fluid is shown to be limited to the capacity extent of the thermal boundary layer. This phenomenon can be of significance in the determination of the thermal limit of gears accelerating to the point where gear scoring occurs. Steady-state temperature prediction is improved considerably through the use of a variable integration time step that substantially reduces computer time. Computer-generated plots of temperature contours enable the user to animate the propagation of the thermal wave as the gears come into and out of contact, thus contributing to better understanding of this complex problem. This model has a much better capability at predicting gear-tooth temperatures than previous models.
Author

**N89-14453*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**TOOTH CONTACT SHIFT IN LOADED SPIRAL BEVEL GEARS O, IL, 25-27 APR. 1989; SPOSORED BY ASME**
M. Savage, P. C. Altidis, D. G. Lewicki, J. J. Coy, and F. L. Litvin (Illinois Univ., Chicago.) [1989] 12 p Prepared for presentation at the 5th International Power Transmission and Gearing Conference, Chicago, IL, 25-27 Apr. 1989; sponsored by ASME
(Grant NAG3-55; DA Proj. 1L1-61102-AH-45)
(NASA-TM-101438; E-4542; NAS 1.15:101438;
AVSCOM-TR-87-C-36) Avail: NTIS HC A03/MF A01 CSCL 13I

An analytical method is presented to predict the shifts of the contact ellipses of spiral bevel gear teeth under load. The contact ellipse shift is the motion of the tooth contact position from the ideal pitch point to its location under load. The shifts are due to the elastic motions of the gear and pinion supporting shafts and bearings. The calculations include the elastic deflections of the gear shafts and the deflections of the four shaft bearings. The method assumes that the surface curvature of each tooth is constant near the unloaded pitch point. Results from these calculations will help designers reduce transmission weight without seriously reducing transmission performance.
Author

## 38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

**N89-14454#** Technische Physische Dienst TNO-TH, Delft (Netherlands).
**DEVELOPMENT OF A CONTACTLESS OPTOACOUSTIC METHOD FOR NONDESTRUCTIVE TESTING. PART 2: OPTICAL EXCITATION OF ULTRASONIC VIBRATIONS [ONTWIKKELING VAN EEN CONTACTLOZE OPTO-AKOESTISCHE METHODE VOOR NIET-DESTRUCTIEF TESTEN. DEEL 2: OPTISCHE EXCITATIE VAN ULTRASONE TRILLINGEN]**
A. J. A. Bruinsma, J. Vogel, and P. vanZuylen Apr. 1987 80 p In DUTCH
(Contract A85/KLu/106)
(TPD-1987-0-2-Pt-2; ETN-89-93419) Avail: NTIS HC A05/MF A01

The possibilities of optical excitation of elastic waves in metals are discussed. The physical processes that affect the beam characteristics of the excited elastic waves were analyzed and experimentally tested. It is shown that amplitude, radiation pattern, and frequency characteristic of the excited waves can be controlled. This is necessary to apply the method for the detection of fatigue cracks at bolt holes. A glass fiber phased array was designed and tested to direct and focus an acoustic beam. It is expected that an optical pulse energy above 8 mJ is sufficient to exceed the detection threshold of an optical method for the inspection of fatigue cracks.
ESA

**N89-14919*#** California Univ., Berkeley. Dept. of Mechanical Engineering.
**EQUIVALENT LINEARIZATION FOR FATIGUE LIFE ESTIMATES OF A NONLINEAR STRUCTURE Abstract Only**
R. N. Miles *In* Hampton Inst., NASA/American Society for

Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 86 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 14D

# 39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

**N89-14455** Stanford Univ., Calif.
**A UNIFIED MODEL FOR PREDICTING THE STRESS AND STRAIN DISTRIBUTIONS AROUND CRACKS OF ANY LENGTH, INCLUDING ELASTIC, PLASTIC, CREEP AND CYCLIC DEFORMATION Ph.D. Thesis**
Chu-Hwa Lee 1988 320 p
Avail: Univ. Microfilms Order No. DA8808382

A unified model for predicting the stress and strain distributions on the crack plane for an edge cracked specimen with a crack of any size greater than or equal to zero was developed. The material behaviors involved in this model include elasticity, plasticity, creep, and cyclic deformations. Through the use of a single fixed form strain distribution equation in the loading direction valid for short cracks and long cracks, and for sharp as well as blunt cracks, the model unifies a single predictive methodology; and is able to estimate crack blunting behavior. The model's predictions of the stress and strain distribution were compared with other simulations and/or experimental observations. Two important features of the model are: (1) The model is capable of solving crack blunting problems and stress relaxation around crack tips, and (2) The model can predict anomalously high stresses and strains around short cracks. With the help of local failure criteria, the model can be applied to simulate ductile-brittle transitions, fatigue (including crack initiation, short crack growth, long crack propagation, and rupture fracture), and creep crack growth. Dissert. Abstr.

**N89-14456*#** California State Univ. at Long Beach.
**TEMPERATURE EFFECT ON STRESS CONCENTRATION AROUND CIRCULAR HOLE IN A COMPOSITE MATERIAL SPECIMEN REPRESENTATIVE OF X-29A FORWARD-SWEPT WING AIRCRAFT**
Hsien-Yang Yeh Aug. 1988 44 p
(Grant NGT-05-020-412)
(NASA-CR-179439; H-1514; NAS 1.26:179439) Avail: NTIS HC A03/MF A01 CSCL 20K

The theory of anisotropic elasticity was used to evaluate the anisotropic stress concentration factors of a composite laminated plate containing a small circular hole. This advanced composite was used to manufacture the X-29A forward-swept wing. It was found for composite material, that the anisotropic stress concentration is no longer a constant, and that the locations of maximum tangential stress points could shift by changing the fiber orientation with respect to the loading axis. The analysis showed that through the lamination process, the stress concentration factor could be reduced drastically, and therefore the structural performance could be improved. Both the mixture rule approach and the constant strain approach were used to calculate the stress concentration factor of room temperature. The results predicted by the mixture rule approach were about twenty percent deviate from the experimental data. However, the results predicted by the constant strain approach matched the testing data very well. This showed the importance of the inplane shear effect on the evaluation of the stress concentration factor for the X-29A composite plate. Author

**N89-14457*#** Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
**ANALYSIS OF SHELL-TYPE STRUCTURES SUBJECTED TO TIME-DEPENDENT MECHANICAL AND THERMAL LOADING Semiannual Status Report**
G. J. Simitses and R. Riff Oct. 1988 48 p
(Grant NAG3-534)
(NASA-CR-183005; NAS 1.26:183005) Avail: NTIS HC A03/MF A01 CSCL 20K

The objective of this research is to develop a general mathematical model and solution methodologies for analyzing structural response of thin, metallic shell-type structures under large transient, cyclic or static thermomechanical loads. Among the system responses, which are associated with these load conditions, are thermal buckling, creep buckling and racheting. Thus, geometric as well as material-type nonlinearities (of high order) can be anticipated and must be considered in the development of the mathematical model. Furthermore, this must also be accommodated in the solution procedures. Author

**N89-14458#** Iowa Univ., Iowa City. Optimal Design Lab.
**DESIGN SENSITIVITY ANALYSIS AND OPTIMIZATION OF NONLINEAR STRUCTURES: A UNIFIED APPROACH**
J. E. B. Cardoso and J. S. Arora Feb. 1988 250 p
(Grant NSF MSM-86-13314)
(PB88-235171; ODL-88-3; NSF/ENG-88004) Avail: NTIS HC A11/MF A01 CSCL 20L

Described is a unified variational theory of design sensitivity analysis of linear and nonlinear structures for shape, non-shape and material selection problems. The concepts of reference volume and adjoint structure are used to develop the unified viewpoint. A general formula for design sensitivity analysis is derived. Several analytical linear and nonlinear examples are used to interpret various terms of the formula and demonstrate its use. Adjoint state fields are interpreted as sensitivities for the functional related to the primary structure. The sensitivity formula is also derived for the field problem of elastic torsion. A Lagrangian continuum approach is also used to derive the sensitivity formula. The finite element method is used for discretization of the derived general sensitivity equation and equivalence is shown between continuum and discrete models of sensitivity analysis. Several examples of design sensitivity analysis and design optimization are presented. Author

**N89-14459#** Sandia National Labs., Albuquerque, N. Mex.
**SHOCK RESPONSE SPECTRUM ANOMALIES WHICH OCCUR DUE TO IMPERFECTIONS IN THE DATA**
R. G. Bell and N. T. Davie 1988 20 p Presented at the 59th Shock and Vibration Symposium, Albuquerque, NM, 18 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-015846; SAND-88-1486C; CONF-881076-7) Avail: NTIS HC A03/MF A01

Shock response spectra are widely used in analysis, design and qualification of components and systems that are subjected to shock environments. The integrity of the data being used to generate the shock response spectrum is very important. Any inaccuracy such as a spurious spike or a zero shift in the data can have a significant impact on the spectrum. Manipulations of the data, decimation of data, or digital filtering, can also have a definite impact on the shock response spectrum. The degree of influence of the error is not always apparent. The effects of these errors on the generation of shock response spectra is shown for an absolute acceleration spectrum. The awareness of these possible errors is shown to require an understanding of the shock spectrum algorithm and knowledge of the effects of signal processing. DOE

**N89-14460#** Sandia National Labs., Albuquerque, N. Mex. Experimental Mechanics Dept.
**SHAKER SHOCK TESTING USING NONSTATIONARY RANDOM TRANSIENTS**
Thomas L. Paez and Thomas J. Baca 1988 17 p Presented at the 59th Shock and Vibration Symposium, Albuquerque, NM,

18 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-015847; SAND-88-1782C; CONF-881076-8) Avail: NTIS HC A03/MF A01

Shock testing plays a critical role in the development of a wide range of structures. Conducting controlled laboratory shock tests on these structures provides essential data on their ability to survive their operational shock environments. Laboratory test specifications establish equivalence relationships between the actual shock environments and the laboratory shock test inputs. In recent years the electrodynamic shaker has proven itself to be a very versatile machine for applying transients to aerospace components. Shaker control techniques now exist which allow reproduction of shock transients composed of summed deterministic functions (e.g., decaying sinusoids). The results of a study in which nonstationary random transients are used as the basis for defining shaker shocks are discussed. After describing the test specification and implementation procedures, the results of some tests conducted on a simple cantilever beam structure are compared. One test is a direct simulation of a nonstationary random process environment; two other tests represent the shock source using excitations established via the method of shock response spectra. The advantages and limitations of each approach are summarized. DOE

**N89-14461#** Lawrence Livermore National Lab., CA.
**DYNAMICS OF STRUCTURES: SOLUTION TECHNIQUES**
Bruce E. Engelmann Apr. 1988 18 p Presented at the Advanced Study Inst. on Finite Element Analysis, Madras, India, 1 Aug. 1988
(Contract W-7405-eng-48)
(DE88-017022; UCRL-98561; CONF-8808124-2) Avail: NTIS HC A03/MF A01

The increased use of large scale dynamic simulations in various engineering applications is apparent and time integration plays an important role. The use of direct time integration as a solution procedure for finite element semidiscretizations may be advantageous for linear systems, but finds an even greater application in nonlinear analyses. The characteristics of the time integration procedure can have a critical impact on the feasibility of the calculation. The wrong choice of time integrator could be impractical or lead to excessive errors in the simulation. For these reasons, direct time integration has continued to be an active area of research. In this paper, the fundamentals of time integration as well as specific new developments in the area are discussed. The methodologies are presented in a linear setting, but topics related to nonlinear analyses are considered. The primary focus is on the solution of the equations of motion arising in structural dynamics. These are a coupled set of second order, ordinary differential equations resulting from the semidiscretization of the governing hyperbolic partial differential equations. However, much insight on time integration procedures can be gained by studying first order systems due to their simplicity. These systems arise from a semidiscretization of the diffusion equations such as transient heat conduction and are of the parabolic type. The fundamental aspects of time integration are first shown in the context of first order systems. The integration of the equations of motion as well as some guidelines for choosing a particular solution method are discussed. Advances in the field including numerically dissipative algorithms and partitioned time integration procedures are also presented. DOE

**N89-14462#** Lawrence Livermore National Lab., CA.
**DYNAMICS OF STRUCTURES: FUNDAMENTALS**
Bruce E. Engelmann Apr. 1988 16 p Presented at the Advanced Study Institute on Finite Element Analysis, Madras, India, 1 Aug. 1988
(Contract W-7405-eng-48)
(DE88-017027; UCRL-98562; CONF-8808124-1) Avail: NTIS HC A03/MF A01

With the rapid development of more efficient computer hardware and software, dynamic nonlinear numerical simulations are now within the realm of many engineering analyses. As a result, considerable effort has been directed toward the area of structural dynamics. Many new approaches and solution strategies have been proposed to increase the accuracy and efficiency of simulations. The most common approach to structural dynamics is one in which the spatial discretization and temporal solution are performed independently. This is called a semidiscretization. The governing partial differential equations are first discretized in space, yielding a coupled system of ordinary differential equations. A variety of methods may then be used to integrate this system of ordinary differential equations in time. This paper concentrates on developing the equations of structural dynamics, known as the discrete equations of motion, rather than on the solution of these equations. Although most of the following developments are done in a linear context, some references are made to nonlinear analysis. An example of the semidiscretization accomplished through the finite element method is shown for a multidimensional linear continuum. DOE

**N89-14463#** Ceramatec, Inc., Salt Lake City, UT.
**DEVELOPMENT OF A MICROCIRCUIT GRID TECHNIQUE FOR AUTOMATED CRACK LENGTH MEASUREMENT FOR FATIGUE TESTING AT ELEVATED TEMPERATURE Final Report, Jul. 1987 - Feb. 1988**
Kevin Stuffle, Raymond A. Cutler, Dinesh K. Shetty, and Anil V. Virkar May 1988 33 p
(Contract F33615-87-C-3236)
(AD-A198003; AFWAL-TR-88-3031) Avail: NTIS HC A03/MF A01 CSCL 13M

A microcircuit grid technique was investigated and used to measure crack lengths in fatigue crack growth test specimens of an aluminum alloy (7075-T6) at room temperature and a nickel-based superalloy (Inconel 718) at 650 C as part of a Phase 1 SBIR program supported by the Air Force. Crack lengths were determined from stepwise changes in the resistance of microcircuit grids deposited on compact tension specimens by a photolithography process. Crack lengths assessed from discrete voltage changes recorded for a grid on a bridge circuit agreed closely with direct optical measurements. The fatigue crack growth data obtained from both alloys were in agreement with the data in the literature. GRA

**N89-14464#** Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
**THE INFLUENCE OF POROSITY ON SHORT FATIGUE CRACK GROWTH AT LARGE STRAIN AMPLITUDES Technical Report No. 10**
D. A. Gerard and D. A. Koss Jul. 1988 28 p
(Contract N00014-86-K-0381)
(AD-A198477) Avail: NTIS HC A03/MF A01 CSCL 11F

The influence of the pore microstructure (0 to 6 percent) rounded porosity isolated vs. interconnected) on short crack growth behavior during low cycle fatigue has been evaluated using powder-processed titanium as a model system. The presence of porosity enhances short crack propagation adjacent to the pores as a result of localized, pore-induced plasticity. Observations of short cracks using surface replicas indicate that once a crack extends beyond a plastic zone of an isolated pore, it decelerates to propagation rates similar to those observed for fully dense materials of the similar grain sizes. GRA

**N89-14465*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**PARAMETRIC STUDIES OF ADVANCED TURBOPROPS**
J. G. Maser, D. G. Fertis (Akron Univ., OH.), C. C. Chamis, and R. A. Aiello 1988 16 p Presented at the 29th Structures, Structural Dynamics and Materials Conference, Williamsburg, VA, 18-20 Apr. 1988; sponsored by AIAA, ASME, ASCE, AHS and ACS
(NASA-TM-101389; E-4451; NAS 1.15:101389) Avail: NTIS HC A03/MF A01 CSCL 20K

The effects of geometric variables (sweep and twist) on the structural performance of advanced turboprops are investigated. The investigation is limited to aerodynamically efficient turboprops

using an acceptable design configuration as a baseline. The baseline configuration is modified using a seven by seven array of independently varying sweep and twist parameters while maintaining acceptable aerodynamic efficiency. The turboprop structural performance is evaluated in terms of critical speeds, tip displacements, and vibration frequencies where geometric nonlinearities are included. The results obtained are presented in such a manner as to highlight the effects of sweep and twist on the structural performance of aerodynamically efficient turboprop configurations. Author

**N89-14466#** Foster-Miller Associates, Inc., Waltham, MA.
**AUTOMATED FATIGUE CRACK GROWTH MEASUREMENT Final Report, 28 Jul. 1987 - 28 Jan. 1988**
Ted E. Kirchner and John McCoy Jul. 1988 69 p
(Contract F33615-87-C-3240)
(AD-A198642; AFW-8767; AFWAL-TR-88-3032) Avail: NTIS HC A04/MF A01 CSCL 21E

Fatigue testing is a key element in the development of aircraft and engines. The higher performance temperatures of both airframe and engines of future aircraft makes precise high temperature fatigue testing vital. The goal of this program is to develop a new tool that will automate this test and provide fatigue crack measurement to a precision of 0.001 in. at varying temperatures up to 2000 F and likely higher. In the Phase I program reported here we have experimentally shown the feasibility of two different approaches using laser and X-ray technology. We have recommended that the laser approach be selected for hardware development. GRA

**N89-14467#** Fraunhofer Inst. fuer Werkstoffmechanik, Freiburg (Germany, F.R.).
**FRACTURE BEHAVIOUR UNDER IMPACT 2 Final Report, Oct. 1985 - Oct. 1987**
S. Winkler Oct. 1987 71 p
(Contract DAJA45-85-C-0047; DA Proj. 1L1-61103-BH-57)
(AD-A198643) Avail: NTIS HC A04/MF A01 CSCL 20K

The behavior of cracks loaded by impact generated stress pulses is investigated. Depending on the impact arrangement, tension or shear loading at extremely high rates of the stress intensity factor can be realized. With specimens of a high strength steel, a steep increase of the tensile fracture toughness was observed with times-to-fracture decreasing to about 5us. This has been measured with an improved shadow optical technique in reflection. The assumption of an incubation time is used to explain this behavior. GRA

**N89-14468#** Strainoptic Technologies, Inc., North Wales, Pa.
**DIGITAL IMAGE ANALYSIS SYSTEM FOR MONITORING CRACK GROWTH AT ELEVATED TEMPERATURE Final Report, 15 Jul. 1987 - 15 Jan. 1988**
Alex S. Redner and Arkady S. Voloshin May 1988 32 p
(Contract F33615-87-C-3233)
(AD-A198649; AFWAL-TR-88-3030) Avail: NTIS HC A03/MF A01 CSCL 14B

The objective of the research work reported here was to develop a new concept, based on Digital Image Analysis, for monitoring the crack-tip position at elevated temperatures. The proposed system includes: (1) Charge Coupled Device camera observing the crack-tip. (2) PC-based frame grabber, capturing a 512 x 512 pixel frame. (3) Digital Image Analysis software developed to locate and digitize the position of the crack-tip, on the observed image area. (4) Step-motor driven stage, permitting the image-transmitting penetrator to follow the tip as it advances. (5) A penetrator (fiber-optic or lenses) transmitting the magnified image from the vicinity of the crack-tip to the camera. The system was designed, assembled, and tested. Also, a program was developed for digitizing the crack-tip position. To evaluate the feasibility of the concept, its potential accuracy, resolution, temperature limitation and usefulness the system was tested at room and elevated temperature. The results of the testing and evaluation prove that the proposed concept is feasible, practical, and capable of performing at temperatures exceeding initial expectations. GRA

**N89-14469*#** George Washington Univ., Washington, DC. School of Engineering and Applied Science.
**RESPONSE OF COMPOSITE PLATES SUBJECTED TO ACOUSTIC LOADING Final Technical Report**
E. Thomas Moyer, Jr. Jan. 1989 83 p
(Grant NAG1-158)
(NASA-CR-184618; NAS 1.26:184618) Avail: NTIS HC A05/MF A01 CSCL 20K

The objectives of the project were to investigate numerical methodology for the determination of narrowband response in the geometrically nonlinear regime, to determine response characteristics for geometrically nonlinear plates subjected to random loading and to compare the predictions with experiments to be performed at NASA-Langley. The first two objectives were met. The response of composite plates subjected to both narrowband and broadband excitation were studied and the results are presented and discussed. Author

**N89-14470*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**A REVIEW OF FAILURE MODELS FOR UNIDIRECTIONAL CERAMIC MATRIX COMPOSITES UNDER MONOTONIC LOADS**
David E. Tripp, John H. Hemann (Cleveland State Univ., OH.), and John P. Gyekenyesi [1989] 19 p Proposed for presentation at the 34th International Gas Turbine and Aeroengine Congress and Exposition, Toronto, Ontario, 4-8 Jun. 1989; sponsored by the American Society of Mechanical Engineers
(NASA-TM-101421; E-4520; NAS 1.15:101421) Avail: NTIS HC A03/MF A01 CSCL 20K

Ceramic matrix composites offer significant potential for improving the performance of turbine engines. In order to achieve their potential, however, improvements in design methodology are needed. In the past most components using structural ceramic matrix composites were designed by trial and error since the emphasis of feasibility demonstration minimized the development of mathematical models. To understand the key parameters controlling response and the mechanics of failure, the development of structural failure models is required. A review of short term failure models with potential for ceramic matrix composite laminates under monotonic loads is presented. Phenomenological, semi-empirical, shear-lag, fracture mechanics, damage mechanics, and statistical models for the fast fracture analysis of continuous fiber unidirectional ceramic matrix composites under monotonic loads are surveyed. Author

**N89-14471#** Ecole des Mines, Paris (France). Centre des Materiaux.
**FATIGUE EVOLUTION OF SMALL TWO AND THREE DIMENSIONAL CRACKS UNDER VARIABLE AND CONSTANT AMPLITUDE LOADING Final Report [EVOLUTION PAR FATIGUE DE PETITES FISSURES BI ET TRIDIMENSIONNELLES SOUS DES CHARGEMENTS D'AMPLITUDE CONSTANTE ET VARIABLE]**
9 Sep. 1988 314 p In FRENCH
(Contract DRET-87-11-64)
(MM-AL/AP-04-88; ETN-89-93601) Avail: NTIS HC A14/MF A01

Load tests were carried out using two aluminum alloys with different tensile behavior, 2124T351 and 7475T7351. Loading was either monotone or including overloading. The parameters governing crack propagation are identified as related to the opening k value. The difficulties related to the practical determination of this parameter are discussed. The effects related to surcharges are attributed to the plasticity of the materials. ESA

**N89-14472*#** Lockheed Missiles and Space Co., Palo Alto, CA. Research and Development Div.
**THE COMPUTATIONAL STRUCTURAL MECHANICS TESTBED ARCHITECTURE. VOLUME 1: THE LANGUAGE**

Carlos A. Felippa Dec. 1988 95 p
(Contract NAS1-18444)
(NASA-CR-178384; NAS 1.26:178384; LMSC-D878511) Avail: NTIS HC A05/MF A01 CSCL 20K

This is the first set of five volumes which describe the software architecture for the Computational Structural Mechanics Testbed. Derived from NICE, an integrated software system developed at Lockheed Palo Alto Research Laboratory, the architecture is composed of the command language CLAMP, the command language interpreter CLIP, and the data manager GAL. Volumes 1, 2, and 3 (NASA CR's 178384, 178385, and 178386, respectively) describe CLAMP and CLIP, and the CLIP-processor interface. Volumes 4 and 5 (NASA CR's 178387 and 178388, respectively) describe GAL and its low-level I/O. CLAMP, an acronym for Command Language for Applied Mechanics Processors, is designed to control the flow of execution of processors written for NICE. Volume 1 presents the basic elements of the CLAMP language and is intended for all users. Author

**N89-14473*#** Lockheed Missiles and Space Co., Palo Alto, CA.
**APPLICATION DEVELOPER'S TUTORIAL FOR THE CSM TESTBED ARCHITECTURE**
Phillip Underwood and Carlos A. Felippa (Colorado Univ., Boulder.) Oct. 1988 94 p
(Contract NAS1-18444)
(NASA-CR-181732; NAS 1.26:181732; LMSC-D8785111) Avail: NTIS HC A05/MF A01 CSCL 20K

This tutorial serves as an illustration of the use of the programmer interface on the CSM Testbed Architecture (NICE). It presents a complete, but simple, introduction to using both the GAL-DBM (Global Access Library-Database Manager) and CLIP (Command Language Interface Program) to write a NICE processor. Familiarity with the CSM Testbed architecture is required. Author

**N89-14474*#** Lockheed Missiles and Space Co., Palo Alto, CA. Research and Development Div.
**THE CSM TESTBED MATRIX PROCESSORS INTERNAL LOGIC AND DATAFLOW DESCRIPTIONS**
Marc E. Regelbrugge and Mary A. Wright Dec. 1988 91 p
(Contract NAS1-18444)
(NASA-CR-181742; NAS 1.26:181742) Avail: NTIS HC A05/MF A01 CSCL 20K

This report constitutes the final report for subtask 1 of Task 5 of NASA Contract NAS1-18444, Computational Structural Mechanics (CSM) Research. This report contains a detailed description of the coded workings of selected CSM Testbed matrix processors (i.e., TOPO, K, INV, SSOL) and of the arithmetic utility processor AUS. These processors and the current sparse matrix data structures are studied and documented. Items examined include: details of the data structures, interdependence of data structures, data-blocking logic in the data structures, processor data flow and architecture, and processor algorithmic logic flow. Author

**N89-14475*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**IMAT (INTEGRATED MULTIDISCIPLINARY ANALYSIS TOOL) USER'S GUIDE FOR THE VAX/VMS COMPUTER**
Frances T. Meissner, ed. Dec. 1988 231 p
(NASA-TM-101500; NAS 1.15:101500) Avail: NTIS HC A11/MF A01 CSCL 20K

The Integrated Multidisciplinary Analysis Tool (IMAT) is a computer software system for the VAX/VMS computer developed at the Langley Research Center. IMAT provides researchers and analysts with an efficient capability to analyze satellite control systems influenced by structural dynamics. Using a menu-driven executive system, IMAT leads the user through the program options. IMAT links a relational database manager to commercial and in-house structural and controls analysis codes. This paper describes the IMAT software system and how to use it. Author

**N89-14932*#** Ohio State Univ., Columbus. Dept. of Engineering Mechanics.
**THE INFLUENCE OF AND THE IDENTIFICATION OF NONLINEARITY IN FLEXIBLE STRUCTURES Abstract Only**
Lawrence D. Zavodney *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 108-109 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20K

# 42 GEOSCIENCES (GENERAL)

**N89-14476*#** National Aeronautics and Space Administration, Washington, DC.
**NASA GEODYNAMICS PROGRAM SUMMARY REPORT, 1979-1987 PROGRESS AND FUTURE OUTLOOK Geodynamics Program Report No. 6**
Dec. 1988 153 p
(NASA-TM-4065; NAS 1.15:4065) Avail: NTIS HC A08/MF A01 CSCL 08G

This, the sixth Geodynamics Program report, summarizes the program's achievements from its initiation in 1979 through the end of calender year 1987. Author

# 43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

**N89-14477#** National Academy of Sciences - National Research Council, Washington, DC. Commission on Physical Sciences, Mathematics and Resources.
**GEOLOGIC MAPPING IN THE US GEOLOGICAL SURVEY**
1987 34 p
(Grant DI-14-08-0001-A-0468)
(PB88-223870) Avail: NTIS HC A03/MF A01 CSCL 08B

The Subcommittee on Geologic Mapping of the Committee Advisory to the U.S. Geological Survey (USGS) was convened to determine the status and extent of the geologic mapping program and activities of the USGS. Three meetings were held with representatives of the USGS office of Regial Geology, Mineral Resources, Energy and Marine Geology, and Earthquekes, Volcanoes, and Engineering. Programs covered included geologic framework and synthesis, Cooperative Geologic Mapping Program, regional geology branch programs, Isotope Geology Program, wildnerness, GEODAT, statehic and critical materials, land administered by the Bureau of Land Management, coal resources, marine geology and the Pacific and Atlantic, oil and gas resources, energy and minerals, volcanic hazards and geology, engineering seismology and geology, engineering geology and tectonism, and igneous and geothermal processes. GRA

**N89-14478** Texas Univ., Austin.
**SIMULATION AND ANALYSIS OF A GEOPOTENTIAL RESEARCH MISSION Ph.D. Thesis**
Lisa Kay White 1987 216 p
Avail: Univ. Microfilms Order No. DA8806434

The Geopotential Research Mission (GRM) is a proposed mission that uses two satellites in nearly identical orbits to determine the earth's geopotential field using measurements of relative range rate between the two satellites. In the current proposal, the satellites will be in polar orbits, at an altitude of 160 kilometers, but separated by several hundred kilometers. A drag compensation system will be used to eliminate the nonconservative forces that affect the purely gravitational trajectories of the

satellites. Methods were investigated for the determination of the initial conditions for the two satellites that will satisfy the mission requirements. A technique was developed to eliminate the drift between the two satellites caused by gravitational modeling errors and return them to repeating groundtracks. This technique is independent of the geopotential field and other perturbations that were neglected in the pre-mission model. The concept of frozen orbits was also investigated for possible GRM orbits. The effects of temporal perturbations on the relative range-rate signals were also investigated. Dissert. Abstr.

**N89-14479*#** Kansas Univ. Center for Research, Inc., Lawrence. Radar Systems and Remote Sensing Lab.

**INVESTIGATION OF RADAR BACKSCATTERING FROM SECOND-YEAR SEA ICE**

Guang-tsai Lei, Richard K. Moore, and S. P. Gogineni Feb. 1988 67 p

(Contract NASA Order W-16712; N00014-85-K-0200)

(NASA-CR-180986; NAS 1.26:180986; RSL-TR-3311-7) Avail: NTIS HC A04/MF A01 CSCL 08L

The scattering properties of second-year ice were studied in an experiment at Mould Bay in April 1983. Radar backscattering measurements were made at frequencies of 5.2, 9.6, 13.6, and 16.6 GHz for vertical polarization, horizontal polarization and cross polarizations, with incidence angles ranging from 15 to 70 deg. The results indicate that the second-year ice scattering characteristics were different from first-year ice and also different from multiyear ice. The fading properties of radar signals were studied and compared with experimental data. The influence of snow cover on sea ice can be evaluated by accounting for the increase in the number of independent samples from snow volume with respect to that for bare ice surface. A technique for calculating the snow depth was established by this principle and a reasonable agreement has been observed. It appears that this is a usable way to measure depth in snow or other snow-like media using radar. Author

**N89-14480#** Earth Satellite Corp., Chevy Chase, MD.

**REMOTE SENSING TECHNOLOGIES AND SPATIAL DATA APPLICATIONS Final Research Report, 1986 - 1987**

William G. Brooner, Earl S. Merritt, Michael Place, Robert M. Ragan, Donald Wiesnet, and Morris Deutsch (Satellite Hydrology, Inc., Vienna, VA.) Dec. 1987 154 p

(Contract DACW05-87-C-0012)

(AD-A195809; RD-29) Avail: NTIS HC A08/MF A01 CSCL 17H

In the last decade, significant new tools have become available for planners, managers and scientists working in hydrologic engineering. Two new and significant tools are the widespread availability of spaceborne multi-spectral remote sensing systems, and the development of more sophisticated and less expensive micro computer work stations for both image processing and spatial data(GIS)analyses. This paper describes an evaluation of emerging remote sensing and spatial data capabiiities and applications performed for the Corps of Engineers Hydrologic Engineering Center at Davis, California. It first surveys recent and planned spaceborne remote sensing systems providing data relevant to the hydrologic community. Next, integraded digital image processing and Geographic Information Systems(GIS)available today on microcomputers for applied hydrologic analyses are reviewed. Finally, the interaction of these capabilities is examined in the context of specific hydrologic engineering and planning tasks, ranging from real-time flood forecasting, to urban watershed modeling, to snow cover, evaporation, and soil moisture estimation. GRA

**N89-14481*#** California Univ., Santa Barbara.

**REMOTE SENSING INFORMATION SCIENCES RESEARCH GROUP Final Report, Year 5**

John E. Estes, Terence Smith, and Jeffrey L. Star 1 Jun. 1988 61 p

(Grant NAGw-455)

(NASA-CR-183374; NAS 1.26:183374) Avail: NTIS HC A04/MF A01 CSCL 05B

Research conducted under this grant was used to extend and expand existing remote sensing activities at the University of California, Santa Barbara in the areas of georeferenced information systems, matching assisted information extraction from image data and large spatial data bases, artificial intelligence, and vegetation analysis and modeling. The research thrusts during the past year are summarized. The projects are discussed in some detail. B.G.

**N89-14482#** Forest Service, Washington, DC. Engineering Staff.

**SPACE SHUTTLE LARGE FORMAT CAMERA PHOTOGRAPHY CLOUD COVER INTERFERENCE DIAGRAMS Final Report**

Jerry D. Greer Jul. 1988 24 p

(PB88-244405; EM-7140-17) Avail: NTIS HC A03/MF A01 CSCL 14E

High-resolution photographs of the Earth's land features acquired by space vehicles can present information that is not obvious on other types of imagery. For investigators interested in resources, the land must be visible on the photograph. This is not generally the case with imagery acquired during the October 1984 flight of the Space Shuttle Challenger carrying the large format camera. The report reviews and compares various records concerning the cloud cover. The imagery of the United States is reviewed, and frame-by-frame sketch diagrams of cloud cover are presented. GRA

**N89-14483#** SACLANT ASW Research Center, La Spezia (Italy).

**MAKE-MAP AND MEDMAP: TWO PROGRAMS FOR PLOTTING MAPS OF THE MEDITERRANEAN SEA**

P. Scrimger and A. Trangeled Jun. 1988 26 p

(AD-A198491; SACLANTCEN-SM-207) Avail: NTIS HC A03/MF A01 CSCL 08B

Two FORTRAN computer programs MAKE-MAP and MEDMAP are described which, when used together, will plot maps of all or any portion of the Mediterranean Sea. Examples are given which show the high degree of detail provided by the 2' resolution of the database. A description of how the maps are created in MAKE-MAP program by means of intermediate landmass matrices is given, and applications of these landmass matrices are mentioned. A flow chart of the main stages of this program is given. The landmass matrix is read by MEDMAP which uses an interpolating contour routine to plot the coastline; a flow chart of the program is given. FORTRAN listings for MAKE-MAP and MEDMAP are also included. GRA

**N89-14484#** SACLANT ASW Research Center, La Spezia (Italy). Undersea Research Center.

**THE NUMERICAL SIMULATION OF INFRARED SATELLITE MEASUREMENTS OVER THE GREENLAND-ICELAND-NORWEGIAN SEA**

P. J. Minnett Jun. 1988 64 p

(AD-A198653; SACLANTCEN-SR-137) Avail: NTIS HC A04/MF A01 CSCL 08C

The accuracy with which self-calibrating satellite infrared radiometers can measure sea-surface temperature is limited by the modification of the electromagnetic radiation before it reaches the radiometer. These physical effects are described for the spectral interval of infrared wavelengths from approx 10 to approx 14 microns and the split-window expression for sea-surface temperature is derived and discussed. An accurate numerical line-by-line model of the radiative transfer through the atmosphere is presented and is used to simulate measurements of the Advanced Very High Resolution Radiometer (AVHRR/2) on the NOAA series of near-polar orbiting satellites for conditions of the region of the Greenland, Iceland and Norwegian Seas. A set of regionally optimized zenith-angle dependent coefficients for the split-window algorithm is derived and its error characteristics are discussed. While the benefit of using such coefficients is demonstrated, the errors resulting from failing to account properly

for seasonal changes in this particular region are shown to be relatively small. The FORTRAN programs used for the AVHRR/2 simulations at SACLANTCEN are described in appendices. GRA

**N89-14485#** Technische Hogeschool, Delft (Netherlands). Faculty of Geodesy.
**ON THE CONNECTION OF GEODETIC POINT FIELDS IN RESEAU EUROPEAN TRIGONOMETRIQUE (RETRIG) AND RELATED TESTS FOR MODEL ERRORS Thesis**
Anton J. M. Kosters 1988 105 p
(ETN-89-93327) Avail: NTIS HC A06/MF A01

A general view of connection problems in geodesy is presented, with worked out practical examples from the adjustment of the European Triangulation RETRIG. The problems studied include combining two RETRIG blocks, using their common points, and combining satellite derived coordinates with terrestrial ellipsoidal coordinates. Attention is given to the use of two- and three-dimensional statistical tests on station coordinates and to the use of substitute covariance matrices for coordinates. Computing results are presented. ESA

**N89-14486#** Technische Hogeschool, Delft (Netherlands). Faculty of Geodesy.
**PRECISION OF LINE FOLLOWING IN DIGITAL IMAGES [PRECISIE VAN LIJNVOLGING IN DIGITALE BEELDEN]**
Erik Bruel Feb. 1988 73 p In DUTCH; ENGLISH summary
(B8821610; ETN-89-93329) Avail: NTIS HC A04/MF A01

The precision of two line following methods for digital images was compared by scanning a large scale aerial color photo. A technique in three phases: smoothing, edge detection, and line following was used. The optimal combination of smoothing filter, gradient operation, and line following method was found. Dynamic programming is found to be the optimal line following method. The algorithm works faster and the visual results are much better than those of edge relaxation. The precision of both methods is nearly equal. Different smoothing filters and gradient operators do not affect the results. Because of the high quality of the aerial image, it might be possible to use simpler operators. ESA

**N89-14487#** Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
**ON THE CONNECTION OF DIGITIZED MAPS TO A UNIFORM COORDINATE SYSTEM. A SPECIAL CASE OF THE GEODETIC CONNECTION PROBLEM Thesis**
Frank Kenselaar Nov. 1987 103 p
(B8821602; ETN-89-93330) Avail: NTIS HC A06/MF A01

Delft theory is used for the connection of geodetic point fields. The transformation between two coordinate systems is determined by a least squares solution from a set of connection points. A stochastic model is described, as well as the algorithm for an iterative solution. An analytical solution for the connection with a similarity or affine transformation is also given. The formulas of the reliability of the connection are discussed. A designed configuration can be analyzed using these formulas. ESA

**N89-14488#** Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
**HOMOGENEOUS PLATE DEFORMATION AS MONITORED BY SATELLITE LASER RANGING (SLR) AND ANALYZED USING 3D AFFINE TRANSFORMATION MODELS Thesis**
Marleen M. M. Elderhorst Apr. 1988 51 p
(B8821604; ETN-89-93331) Avail: NTIS HC A04/MF A01

The homogeneous deformation of continuous tectonic plates is described by a simplified three-dimensional affine transformation model with 12 parameters relating position vectors of plate material points in two different coordinate systems. The affine transformation model is decomposed in translational, rotational, and pure deformation components and expressed in Cartesian and spherical coordinates. Plate deformation is monitored by the repeated determination of a widely spaced SLR network. Assuming a spherical Earth with invariant radius, horizontal distortion of the network along the surface of the plate is expressed in terms of angular baseline extensions and affine transformation parameters. ESA

**N89-14489#** Technische Hogeschool, Delft (Netherlands). Faculty of Geodesy.
**VARIANCE COMPONENTS ESTIMATION IN TWO DIMENSIONAL GEODETIC NETWORKS Thesis [VARIANTIE-COMPONENT SCHATTING IN TWEE-DIMENSIONELE GEODETISCHE NETWERKEN]**
J. W. Slagmolen May 1988 134 p In DUTCH
(ETN-89-93332) Avail: NTIS HC A07/MF A01

A computer program was developed for the determination of the variance components of geodetic networks. It is shown that the computer time increases strongly with the number of observations and conditions, that a reliable estimation requires a large number of supernumerary data in the network, and that the estimates hardly depend on the a priori valves of the standard deviations. ESA

**N89-14490#** Technische Hogeschool, Delft (Netherlands). Faculty of Geodesy.
**AUTOMATIC PROCEDURE TO FIND CORRESPONDING POINTS IN CCD AIRBORNE EXPERIMENTAL SCANNER FOR APPLICATIONS IN REMOTE SENSING (CAESAR) IMAGES Thesis [EEN AUTOMATISCHE PROCEDURE TER VERKRIJGING VAN CORRESPONDERENDE PUNTEN IN CAESAR-BEELDEN]**
W. J. Looyen Feb. 1988 67 p In DUTCH; ENGLISH summary Original contains color illustrations
(B8821609; ETN-89-93333) Avail: NTIS HC A04/MF A01

An automatic procedure for finding corresponding points in images of the multispectral scanner CAESAR is described. First, the CAESAR images are geometrically corrected using inertial systems data and a geometrical analysis. These images are then used in an automatic procedure to calculate the geometrical tranformation model between the images in order to use the spectral information as well as possible. Correlation techniques are used. Using two images, in the first one interesting points are found applying the Moravec operator. The corresponding points in the second image are determined using a two-dimensional cross correlation. From the two point lists the geometrical transformation model can be calculated, after which a resampling takes place to match the images. ESA

**N89-14491#** Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
**THE USE OF SHORT RANGE STEREOPHOTOGRAMMETRY FOR FACIAL ASYMMETRY AND GROWTH STUDIES; ANALYSIS AND MODEL Thesis**
Hedwig Verhoef Nov. 1987 103 p
(B8821611; ETN-89-93334) Avail: NTIS HC A06/MF A01

A mathematical model was developed based on Delft theory geodetic principles and experiments were carried on using two synchronized semimetric cameras. The problems connected with the final accuracy of the photogrammetrically obtained data are discussed. The method appears to provide a good means to obtain the necessary data to study facial symmetry and growth, although the presented models have to be studied in more detail. ESA

**N89-14492#** Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
**A STUDY ON LEAST-SQUARES PREDICTION AND COLLOCATION Thesis**
R. P. vanEtten Mar. 1988 10107 p
(ETN-89-93336) Avail: NTIS HC A99/MF E11

Collocation is defined as the extension of geodesy least squares prediction to the case of multiple observation types and a collocation method is described using data from geostatistics and mining. It is shown that the procedure is not much different from familiar methods, although the generalized variances do show interesting qualities. Practical aspects of least squares collocation are examined including computation of degree variances, problems

with the full covariance matrix, and hypothesis testing. Prediction results which confirm the potential of the method are presented. ESA

**N89-14493#** Technische Hogeschool, Delft (Netherlands). Faculty of Geodesy.
**VERY LONG BASELINE INTERFEROMETRY (VLBI): RELATIVITY AND GEODESY Thesis [VLBI: RELATIVITEIT EN GEODESIE]**
Leendert Boer May 1988 95 p In DUTCH; ENGLISH summary
(ETN-89-93337) Avail: NTIS HC A05/MF A01

Relativistic effects to be taken into account in geodetic VLBI measurements are discussed. The delay of a radio signal is derived in a barycentric system which is then transformed via a Lorentz transformation into a terrestrial system in order to relate it with geodetic VLBI measurements. The relativistic deflection of radio waves is derived in the gravitational fields of the Sun, the planets and the Earth, and is found to be strongly related to the value of the so-called gravitational deflection parameter gamma. A model was developed to estimate the gamma parameter and was implemented. It is shown that VLBI is a suitable method to test the general theory of relativity via this parameter. ESA

**N89-14494#** Technische Hogeschool, Delft (Netherlands). Faculty of Geodesy.
**FRANK: SOME ASPECTS OF THE PROCESSING OF OBSERVATIONS USING THE INTERPRETATION INSTRUMENT; MEASURING METHODS, INSTRUMENTAL ERRORS AND PREPROCESSING OF THE OBSERVATIONS Thesis [FRANK: ENKELE ASPECTEN VAN DE VERWERKING VAN WAARNEMINGEN GEDAAN MET HEK UITWERKINGSINSTRUMENT: DE MEETMETHODIEK, INSTRUMENTELE FOUTEN EN VOORVERWERKING VAN DE WAARNEMINGEN]**
Vincent deHaas May 1988 140 p In DUTCH
(ETN-89-93338) Avail: NTIS HC A07/MF A01

The system FRANK is described. It consists of a registration, an interpretation and a calculation system. The registration system consists of a photographic camera with a fisheye lens; the camera provides pictures that allow a sufficiently accurate measurement. The interpretation system consists of two measuring tables with matrix cameras and a microcomputer control. The calculation system has a software package for the computation and adjustment of the measured points. The final editing phase provides topographic information from the measured coordinates. ESA

**N89-14495#** Physics and Electronics Lab. TNO, The Hague (Netherlands).
**SPECULAR REFLECTION COEFFICIENT OF SNOW AT 10, 35 AND 94 GHz AS A FUNCTION OF GRAZING ANGLE (OBERJETTENBERG-CAMPAIGN)**
M. P. J. G. Versleyen Nov. 1988 75 p
(Contract A79/K/106)
(FEL-1988-01; TD-88-0504; ETN-89-93416) Avail: NTIS HC A04/MF A01

Measurements were carried out at a military site using two mobile stations with a transmitter and a receiver each. Antennas with large beam widths and 10 GHz open waveguides were used. The results show heavy fluctuations of reflection and strong position dependence. It is shown that under the given snow conditions macroscopic surface roughness is the main factor causing the observed fluctuations. Internal or multiple reflections do not give a relevant contribution to total reflection. ESA

**N89-15046*#** Geological Survey, Flagstaff, AZ.
**MAPPING EXPERIMENT WITH SPACE STATION Abstract Only**
Sherman S. C. Wu *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 08B

# 44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

**N89-14496#** Institute of Gas Technology, Chicago, IL.
**ADVANCED CONCEPTS FOR CONTAMINANT RESISTANT FUEL CELLS**
Robert J. Remick 1987 11 p Presented at the 14th Annual Energy Technology Conference and Exposition, Washington, DC, 14 Apr. 1987
(Contract DE-AC21-86MC-23023)
(DE88-017151; CONF-870416-7) Avail: NTIS HC A03/MF A01

It has been shown that both the phosphoric acid fuel cell and the molten carbonate fuel cell are adversely affected by the presence of trace amounts of sulfur in the fuel supply. Unfortunately, coal gasifier derived fuel streams contain anywhere from 200 to 4000 ppM of sulfur even when operated on low sulfur coals. Therefore, for the combination of a coal gasifier and a fuel cell power plant to become a reality, processes for removing sulfur from fuel streams to levels of less than 5 ppM must be developed or a method must be found to increase the sulfur tolerance of these fuel cells. Two such methods for increasing the sulfur tolerance of molten carbonate fuel cells are currently under investigation at IGT under DOE/METC sponsorship. One method utilizes a hydrogen permeable membrane to remove the hydrogen fuel from the contaminated gas stream. The other method seeks to identify and develop sulfur tolerant anode materials which are unaffected by sulfur contaminants in the fuel. DOE

**N89-14497#** Midwest Research Inst., Golden, CO. Solar Energy Research Inst.
**US PHOTOVOLTAIC PATENTS, 1951--1987**
Sep. 1988 615 p
(Contract DE-AC02-83CH-10093)
(DE88-001178; SERI/SP-210-3357) Avail: NTIS HC A99/MF A01

This document contains 2195 U.S. patents on terrestrial photovoltaic (PV) power applications, including systems, components, and materials as well as manufacturing and support functions. The patent entries in this document were issued from 1951 through 1987; no patents were found in 1950. The entries were located by searching USPA, the data base of the U.S. Patent Office. The final search retrieved all patents under the class Batteries, Thermoelectric and Photoelectric, and the subclasses Photoelectric, Testing, and Applications. The search also located patents that contained the words photovoltaic(s) or solar cell(s) and their derivatives. A manual search of the patents in the Solar Energy Research Institute (SERI) patent file augmented the data base search. After the initial list was compiled, most of the patents on the following subjects were excluded: space photovoltaic technology, use of the photovoltaic effect for detectors, and subjects only peripherally concerned with photovoltaics. Some patents on these three subjects were included when it appeared that those inventions might be of use in terrwstrial PV power technologies. DOE

**N89-14498#** Sandia National Labs., Albuquerque, N. Mex.
**PHOTOVOLTAICS AS AN OPERATING ENERGY SYSTEM**
G. J. Jones, H. N. Post, and M. G. Thomas 1988 10 p Presented at the International Renewable Energy Conference, Honolulu, HI, 18 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE88-017167; SAND-88-2349; CONF-880932-2) Avail: NTIS HC A02/MF A01

In the short time since the discovery of the modern solar cell in 1954, terrestrial photovoltaic power system technology has matured in all areas, from collector reliability to system and

subsystem design and operations. Today's PV systems are finding widespread use in powering loads where conventional sources are either unavailable, unreliable, or too costly. A broad range of applications is possible because of the modularity of the technology---it can be used to power loads ranging from less than a watt to several megawatts. This inherent modularity makes PV an excellent choice to play a major role in rural electrification in the developing world. The future for grid-connected photovoltaic systems is also very promising. Indications are that several of today's technologies, at higher production rates and in megawatt-sized installations, will generate electricity in the vicinity of $0.12/kWh in the near future. DOE

**N89-14499#** Sandia National Labs., Albuquerque, N. Mex.
**MEASUREMENT PRECAUTIONS FOR HIGH-RESISTIVITY SILICON SOLAR CELLS**
D. L. King, J. M. Gee, and B. R. Hansen 1988 5 p Presented at the 20th IEEE Photovoltaic Specialists Conference, Las Vegas, NV, 26 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE89-000438; SAND-88-0600C; CONF-880965-4) Avail: NTIS HC A02/MF A01

Due to features such as bulk carrier lifetimes on the order of 1 ms, excellent surface passivation, and light trapping, several measurement characteristics have been identified that are unique to high-performance, high-resistivity silicon cells. These unique characteristics can lead to large performance measurement errors. They also offer insight to the physical mechanisms occurring in these devices. Topics to be discussed and illustrated with measured results include a strong fill factor dependence on voltage sweep rate and direction, sublinear short-circuit current versus irradiance, light soaking influence on open-circuit voltage and fill factor, and enhanced spectral response beyond 1100 nm due to optical light trapping. DOE

**N89-14500#** Sandia National Labs., Albuquerque, N. Mex.
**CRYSTALLINE SILICON PHOTOVOLTAIC CELL TECHNOLOGY: MEETING THE CHALLENGE FOR UTILITY POWER**
D. E. Arvizu 1988 9 p Presented at the 20th IEEE Photovoltaic Specialists Conference, Las Vegas, NV, 26 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE89-000439; SAND-88-0630C; CONF-880965-9) Avail: NTIS HC A02/MF A01

This paper discusses the recent progress in U.S. crystalline silicon photovoltaic cell technology for both one-sun and concentrating applications. The progress in crystalline silicon technology has manifested itself in improved efficiency and in lower costs of processing and production. High efficiency cell designs that have been pioneered in the research laboratory are now finding their way into the production environment and we continue to project decreases in levelized energy costs for next generation systems over systems recently fielded in utility scale projects. The new developments in crystalline silicon photovoltaic technology have prompted an optimistic assessment of its potential for utility applications. The status of the current research efforts and the direction of the U.S. Department of Energy sponsored crystalline silicon research program will be discussed. DOE

**N89-14501#** Sandia National Labs., Albuquerque, N. Mex.
**THE EFFECT OF PARASITIC ABSORPTION LOSSES ON LIGHT TRAPPING IN THIN SILICON SOLAR CELLS**
J. M. Gee 1988 6 p Presented at the 20th IEEE Photovoltaic Specialists Conference, Las Vegas, NV, 26 Sep. 1988
(Contract DE-AC04-76DP-00789)
(DE89-000457; SAND-88-0627C; CONF-880965-8) Avail: NTIS HC A02/MF A01

Recently, methods to enhance the optical adsorption (i.e., light trapping) of thin silicon solar cells have been investigated by several groups. We have investigated the effect of parasitic adsorption (PA) losses on light trapping in thin silicon cells. Parasitic adsorption refers to an optical adsorption process which does not generate an electron/hole pair; it competes with band-to-band adsorption to decrease the photocurrent. A simple model for light trapping that includes PA is described for interpretation of experimental data. The sub-bandgap reflectance is shown to be a sensitive and quantitative indicator of PA losses. Finally, minimization of the PA losses is shown to be as important as optimization of the light-trapping geometry for increased photogeneration in light-trapping thin silicon solar cells. DOE

**N89-14502#** Applied Solar Energy Corp., City of Industry, CA.
**RUGGED, THIN GaAs SOLAR CELL DEVELOPMENT Interim Report, Nov. 1985 - Jun. 1987**
Ken Wagner May 1988 50 p
(AD-A198533; AFWAL-TR-88-2011) Avail: NTIS HC A03/MF A01 CSCL 10B

This report describes the phase 2 efforts in developing high efficiency GaAs-ON-Ge solar cells for enhanced survivability, ruggedness, and reduced weight over conventional devices. This work emphasizes efforts to improve the cell performance from phase 1, initial testing of the cells, and fabrication of a module for space flight testing. The specific goals for the program are: An Air Mass Zero (AM0) conversion efficiency of 18 percent for beginning-of-life (BOL) at 27 plus or minus 2 C; An AM0 conversion efficiency of 13.5 percent at 27 plus or minus 2 C after exposure to 5 x 10 to the 15th power (MeV) electrons/sq cm; A cell weight not to exceed 0.05 grams per square centimeter of cell area. GRA

# 45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

**N89-14503*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**POLAR OZONE WORKSHOP. ABSTRACTS**
Arthur C. Aikin May 1988 306 p Workshop held in Snowmass, CO, 9-13 May 1988; sponsored by NASA, NOAA, NSF, Chemical Mfgrs. Association, WMO, and the United Nations Environment Program Sponsored by NASA, Washington, DC
(NASA-CP-10014; Rept-88B0234; NAS 1.55:10014) Avail: NTIS HC A14/MF A01 CSCL 13B

Results of the proceedings of the Polar Ozone Workshop held in Snowmass, CO, on May 9 to 13, 1988 are given. Topics covered include ozone depletion, ozonometry, polar meteorology, polar stratospheric clouds, remote sensing of trace gases, atmospheric chemistry and dynamical simulations. For individual titles, see N89-14504 through N89-14607.

**N89-14504*#** Meteorological Research Inst., Tsukuba (Japan).
**TOTAL OZONE BY LUNAR DOBSON OBSERVATION AT SYOWA, ANTARCTICA**
Shigeru Chubachi, Ryoichi Kajiwara, and Kouji Kondoh (Aerological Observatory, Tsukuba, Japan ) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 3-5
(For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The lunar Dobson observation is almost the only way to get the total ozone in or around the polar night season at high latitudes where the total ozone observation by solar Dobson is not available. The total ozone observations by lunar Dobson were carried out at Syowa Station (69 S, 40 E), Antarctica in 1969, and 1982 to 1986, in the months from March to October. The method, the accuracy and the results of the lunar Dobson observation carried out at Syowa Station from 1982 to 1986 are described. Author

**N89-14505*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**TOTAL OZONE CHANGES IN THE 1987 ANTARCTIC OZONE HOLE Abstract Only**
Arlin J. Krueger, Mark R. Schoeberl, Scott D. Doiron, Frank Sechrist, and Reginald Galimore *In its* Polar Ozone Workshop. Abstracts

May 1988 p 6 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01

The development of the Antarctic ozone minimum was observed in 1987 with the Nimbus 7 Total Ozone Mapping Spectrometer (TOMS) instrument. In the first half of August the near-polar (60 and 70 deg S) ozone levels were similar to those of recent years. By September, however, the ozone at 70 and 80 deg S was clearly lower than any previous year including 1985, the prior record low year. The levels continued to decrease throughout September until October 5 when a new record low of 109 DU was established at a point near the South Pole. This value is 29 DU less than the lowest observed in 1985 and 48 DU less than the 1986 low. The zonal mean total ozone at 60 deg S remained constant throughout the time of ozone hole formation. The ozone decline was punctuated by local minima formed away from the polar night boundary at about 75 deg S. The first of these, on August 15 to 17, formed just east of the Palmer Peninsula and appears to be a mountain wave. The second major minimum formed on September 5 to 7 again downwind of the Palmer Peninsula. This event was larger in scale than the August minimum and initiated the decline of ozone across the polar region. The 1987 ozone hole was nearly circular and pole centered for its entire life. In previous years the hole was perturbed by intrusions of the circumpolar maximum into the polar regions, thus causing the hole to be elliptical. The 1987 hole also remained in place until the end of November, a few days longer than in 1985, and this persistence resulted in the latest time for recovery to normal values yet observed. Author

**N89-14506*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**THE BREAKUP OF THE SOUTHERN HEMISPHERE SPRING POLAR OZONE AND TEMPERATURE MINIMUMS FROM 1979 TO 1987**

Paul A. Newman (Applied Research Corp., Landover, MD.) and Mark R. Schoeberl *In its* Polar Ozone Workshop. Abstracts May 1988 p 7-9 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The purpose of this study is to quantify the observations of the polar vortex breakup. The data used in this study consist of Total Ozone Mapping Spectrometer (TOMS) data, and National Meteorological Center (NMC) analyses. The final warming is diagnosed using the difference between zonal means at 80 degrees and 50 degrees S for temperature, ozone, and layer mean temperature. The polar vortex breakup can also be diagnosed by the onset of weak zonal mean zonal winds (i.e., u, overbar denotes a zonal average) at 60 degrees S. Computations of the polar vortex breakdown date using NMC meteorological data and TOMS total ozone data indicate that the breakdown is occurring later in the spring in the lowest portion of the stratosphere. At altitudes above 100 mb, the large interannual variance of the breakdown date renders any trend determination of the breakdown date difficult. Individual plots of TOMS total ozone indicate that the total ozone minimum remains intact for a longer period of time than is observed in earlier years. Author

**N89-14507*#** National Center for Atmospheric Research, Boulder, CO.

**OBSERVATIONS OF STRATOSPHERIC TEMPERATURE CHANGES COINCIDENT WITH THE RECENT ANTARCTIC OZONE DEPLETIONS**

William J. Randel and Paul A. Newman (Applied Research Corp., Landover, MD.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 10-12 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

A high degree of correlation between the recent decline in Antarctic total ozone and cooling of the stratosphere during Austral spring has been noted in several recent studies (e.g., Sekiguchi, 1986; Angel, 1986). This study analyzes the observed temperature trends in detail, focusing on the spatial and temporal aspects of the observed cooling. Ozone losses and stratospheric cooling can be correlated for several reasons: (1) ozone losses (from an unspecified cause) will directly reduce temperatures due to decreased solar ultraviolet absorption (Shine, 1986), and/or (2) changes in both ozone and temperature structure due to modification of stratospheric circulation patterns (Mahlman and Fels, 1986). In order to scrutinize various ozone depletion scenarios, detailed information on the observed temperature changes is necessary; the goal is to provide such data. The data used are National Meteorological Center (NMC) Climate Analysis Center (CAC) derived temperatures, covering 1000 to 1 mb (0 to 48 km), for the period 1979 to 1987. Discussions on data origin and quality (assessed by extensive comparisons with radiosonde observations), along with other details of these observations, can be found in Newman and Randel (1988). Author

**N89-14508*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**ANTARCTIC MEASUREMENTS OF OZONE, WATER VAPOR, AND AEROSOL EXTINCTION BY SAGE 2 IN THE SPRING OF 1987**

J. C. Larsen (ST Systems Corp., Hampton, Va.) and M. Patrick McCormick *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 13-15 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Recent measurements of ozone, water vapor, and aerosol extinction from the spring of 1987 are presented and compared to 1985 and 1986. The observed changes to variations in meteorological conditions in the vortex for these three years are noted. March ozone data at similar latitudes for these three years will be used to investigate coupling between severity of the springtime depletion and early fall values. Researchers also investigate correlations between the measured species of water vapor, ozone, and aerosols throughout the vortex region. Author

**N89-14509*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**THE THREEE-DIMENSIONAL MORPHOLOGY OF THE ANTARCTIC OZONE HOLE Abstract Only**

Arthur C. Aikin and R. D. McPeters *In its* Polar Ozone Workshop. Abstracts May 1988 p 16 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The three-dimensional morphology of the spring antarctic ozone distribution as determined by the Nimbus 7 Solar Backscatter Ultraviolet (SBUV) spectrometer instrument is presented for the period 1 to 11 October in 1986. The data show that a clearly defined minimum in ozone relative to the local ozone field extends throughout the stratosphere from the tropopause to above 50 km, though decreasing in intensity with altitude. Near 18 km ozone in the ozone hole is 50 percent less than the average surrounding ozone. But even at 50 km the ozone is 20 percent less than the surrounding ozone field. The ozone minimum in the upper stratosphere is displaced about 6 degrees toward the equator so that observations at a fixed station may provide the illusion that the ozone minimum is restricted only to low altitudes. While the ozone minimum is spatially coherent throughout the stratosphere, there are differences in the behavior of ozone at different altitudes that suggest the existence of at least three distinct altitude domains. Below 30 km ozone is characterized by classic ozone hole behavior. Between 33 and 43 km ozone is more stable, actually increasing during September and October. Above 43 km ozone has always decreased during September to a minimum in October, but it has suffered a long term decrease of 7 to 12 percent since 1979 similar to that seen at low altitudes. Author

**N89-14510*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**ESTIMATION OF ERRORS IN THE TOMS TOTAL OZONE MEASUREMENT DURING THE ANTARCTICA OZONE CAMPAIGN OF AUGUST/SEPTEMBER 1987**

P. K. Bhartia, Arlin J. Krueger, S. Taylor, and C. Wellemeyer (ST Systems Corp., Lanham, Md.) *In its* Polar Ozone Workshop.

Abstracts May 1988 p 17-18 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The Total Ozone Mapping Spectrometer (TOMS) instrument on the Nimbus-7 satellite provides the primary source of total ozone data for the study of total ozone in the polar regions of the earth. There are two types of instrument related errors: a slowly developing drift in the instrument calibration since the launch of the instrument in October 1978 and an increase in the measurement noise beginning April, 1984. It is estimated that by October 1987, the accumulated error in the TOMS total ozone measurement due to instrument drift is about 6 m-atm-cm. The sign of the error is such that the TOMS is slightly overpredicting the long-term decrease of the Antarctica ozone. The increase in the measurement noise is more difficult to quantify, affecting some measurements by as much as 10 D.U. and others not at all. A detailed analysis of this error and its potential impact on the studies of total ozone from TOMS will be provided. There are three categories of algorithmic errors: (1) error due the unusual shape of the ozone profile in the ozone hole; (2) error caused by very low atmospheric temperatures in the ozone hole affecting the ozone absorption cross-sections at the TOMS wavelengths; and (3) errors resulting from occasionally thick stratospheric clouds that sometimes reach to 20 km in the ozone hole. Author

**N89-14511*#** National Oceanic and Atmospheric Administration, Washington, DC. Climate Analysis Center.

**NMC STRATOSPHERIC ANALYSES DURING THE 1987 ANTARCTIC EXPEDITION**

Melvyn E. Gelman and Paul A. Newman (Applied Research Corp., Landover, MD.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 19-22 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Stratospheric constant pressure analyses of geopotential height and temperature, produced as part of regular operations at the National Meteorological Center (NMC), were used by several participants of the Antarctic Ozone Expedition. A brief decription is given of the NMC stratospheric analyses and the data that are used to derive them. In addition, comparisons of the analysis values at the locations of radiosonde and aircraft data are presented to provide indications for assessing the representativeness of the NMC stratospheric analyses during the 1987 Antarctic winter-spring period. Author

**N89-14512*#** Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Sciences.

**THE UW DIGITAL OZONESONDE: CHARACTERISTICS AND FLOW RATE CALIBRATION**

J. W. Harder, D. J. Hofmann, J. M. Rosen, and N. T. Kjome *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 23-26 Prepared in cooperation with Wyoming Univ., Laramie (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

During the austral springs of 1986 and 1987, a series of balloon soundings were conducted to characterize the temporal and vertical development of Antarctic ozone depletion using the electrochemical concentration cell method (ECC). An important part of this study was to perform correlative studies between ozone and aerosol particles. In order to facilitate these simultaneous measurements, a digital ozonesonde system was developed to interface with aerosol counters. The ozone measurements will be described herein. The ozonesonde modification was accomplished by converting the current output of the sonde to a frequency and adding this digital signal to the serial data stream of a Vaisala Corporation RS-80 radiosonde under microprocessor control. A number of advantages over the standard ozonesonde system currently in use are noted. Author

**N89-14513*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**SEASONAL AND TEMPORAL CHANGES IN THE VERTICAL PROFILES OF POLAR STRATOSPHERIC OZONE: 1978-1986**

Donald F. Heath *In its* Polar Ozone Workshop. Abstracts May 1988 p 27-28 Prepared in cooperation with National Oceanic and Atmospheric Administration, Boulder, CO (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The long-term changes in stratospheric ozone in both Antarctic and Arctic regions during the period November 1978 to October 1986 exhibit significant interhemispheric differences in terms of time of onset, altitude, latitude, longitude, and phase. The 8-year data set of stratospheric ozone derived from observations with the Nimbus 7 Solar Backscatter Ultraviolet (SBUV) spectrometer instrument were deseasonalized by subtracting monthly deviations from 6-year monthly means for 10 degree bands centered at latitudes 80 S-80 N and the 64x64 standard NMC grid at standard pressure levels in the atmosphere. Linear trends are derived from the linear regression of monthly deviations from long term monthly means in terms of annual and monthly trends for the latitude region 55 to 81 degrees in both hemispheres. An assessment has been made of the SBUV instrument drift from analyses of annual deviations from long term annual means of stratospheric ozone in north temperate regions from 25 N-55 N with corresponding Umkehr observations from 5 stations at latitudes from 36 N-52 N which have been corrected for stratospheric aerosols derived from 5 lidar stations (DeLuisi and Mateer, 1988). Author

**N89-14514*#** Wyoming Univ., Laramie. Dept. of Physics and Astronomy.

**OZONE PROFILE MEASUREMENTS AT MCMURDO STATION ANTARCTICA DURING THE SPRING OF 1987**

D. J. Hofmann, J. W. Harder, J. M. Rosen, J. Hereford, and J. R. Carpenter *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 29-31 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

During the Antarctic spring of 1986, 33 ozone soundings were conducted from McMurdo Station. These data indicated that the springtime decrease in ozone occurred rapidly between the altitudes of 12 and 20 km. During 1987, these measurements were repeated with 50 soundings between 29 August and 9 November. Digital conversions of standard electrochemical cell ozonesondes were again employed. The ozonesonde pumps were individually calibrated for flow rate as the high altitude performance of these pumps have been in question. While these uncertainties are not large in the region of the ozone hole, they are significant at high altitude and apparently resulted in an underestimate of total ozone of about 7 percent (average) as compared to the Total Ozone Mapping Spectrometer (TOMS) in 1986, when the flow rate recommended by the manufacturer was used. At the upper altitudes (approx. 30 km) the flow rate may be overestimated by as much as 15 percent using recommended values (see Harder et al., The UW Digital Ozonesonde: Characteristics and Flow Rate Calibration, poster paper, this workshop). These upper level values are used in the extrapolation, at constant mixing ratio, required to complete the sounding for total ozone. The first sounding was on 29 August, prior to major ozone depletion, when 274 DU total ozone (25 DU extrapolated) was observed. By early October total ozone had decreased to the 150 DU range; it then increased during mid-October owing to motion of the vortex and returned to a value of 148 DU (29 DU extrapolated) on 27 October. Author

**N89-14515*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

**DYNAMICS EXPLORER 1 SOI IMAGES OF THE ANTARCTIC OZONE HOLE**

G. M. Keating, W. E. Bressette, C. Chen, M. C. Pitts, and J. Craven (Iowa Univ., Iowa City.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 32-34

(For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The Dynamics Explorer (DE) satellite carries an Auroral Imaging Package which contains filters designed for performing backscatter ultraviolet measurements to measure total column ozone in the Earth's middle and lower atmosphere. Measurements are obtained at 317.5 mm (to measure ozone absorption) and 360 nm (to measure scene reflectivity). In October 1985 and 1986, measurements were obtained near apogee of the Antarctic ozone hole. The only other high spatial resolution measurements were obtained from the Nimbus 7 Total Ozone Mapping Spectrometer (TOMS) experiment. In October 1987, the Dynamics Explorer apogee had precessed into the Northern Hemisphere preventing measurements of the ozone hole. However, measurements should be obtained from DE of the ozone hole in both 1988 and 1989. Considering that the Nimbus 7 TOMS instrument has long exceeded its expected lifetime, the DE Spin Scan Ozone Imager (SOI) experiment could easily play a crucial role in studies of the ozone hole over the next few years. Author

**N89-14516*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**THE MORPHOLOGY AND METEOROLOGY OF SOUTHERN HEMISPHERE SPRING TOTAL OZONE MINI-HOLES**
Paul A. Newman (Applied Research Corp., Landover, MD.), Leslie R. Lait, and Mark R. Schoeberl *In its* Polar Ozone Workshop. Abstracts May 1988 p 35-37 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The purpose of this paper is to describe the properties of mini-hole events. Both Total Ozone Mapping Spectrometer (TOMS) data and National Meteorological Center (NMC) meteorological analyses will be used to determine the horizontal, vertical and temporal characteristics of the mini-holes. Mini-holes are rapidly developing (1 to 5 days), small horizontal scale (1000 to 3000 km) features which appear in the polar total ozone field during September and October of each year. Typically, a total of 1 to 6 mini-holes appear each year in either the Palmer penninsula region or over the East Antarctica ice sheet. The mini-holes do not develop over these two regions, but they intensify most dramatically there (possibly associated with the local orography). The mini-holes are associated with cold pools of air in the lower stratosphere, anti-cyclonic (geopotential height highs) disturbances to their west, high potential vorticity slightly to the east, and strong northward flow. These meteorological features are baroclinic, having a distinct westward tilt with increasing altitude. Author

**N89-14517*#** Wisconsin Univ., Madison. Dept. of Meteorology.
**GHOST BALLOONS AROUND ANTARCTICA**
Charles R. Stearns *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 38-41 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The GHOST balloon position as a function of time data shows that the atmospheric circulation around the Antarctic Continent at the 100 mb and 200 mb levels is complex. The GHOST balloons supposedly follow the horizontal trajectory of the air at the balloon level. The position of GHOST balloon 98Q for a three month period in 1968 is shown. The balloon moved to within 2 deg of the South Pole on 1 October 1968 and then by 9 December 1968 was 35 deg from the South Pole and close to its position on 1 September 1968. The balloon generally moved from west to east but on two occasions moved in the opposite direction for a few days. The latitude of GHOST balloons 98Q and 149Z which was at 200 mb is given. Both balloons tended to get closer to the South Pole in September and October. Other GHOST balloons at the same pressure and time period may not indicate similar behavior. Author

**N89-14518*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**OZONE PROFILES ABOVE PALMER STATION, ANTARCTICA**
Arnold L. Torres and George Brothers (Chemal, Inc., Wallops Island, VA.) *In its* Polar Ozone Workshop. Abstracts May 1988 p 42-44 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

NASA's Goddard Space Flight Center/Wallops Flight Facility conducted a series of 52 balloon-borne measurements of vertical ozone profiles over the National Science Foundation (NSF) research facility at Palmer Station, Antarctica (64 deg 46 S, 64 deg 3 W) between August 9 and October 24, 1987. High resolution measurements were made from ground level to an average of 10 mb. While much variation was seen in the profile amounts of ozone, it is clear that a progressive depletion of ozone occurred during the measurement period, with maximum depletion taking place in the 17 to 19 km altitude region. Ozone partial pressures dropped by about 95 percent in this region. Shown here are plotted time dependences of ozone amounts observed at 17 km and at arbitrarily selected altitudes below (13 km) and above (24 km) the region of maximum depletion. Ozone partial pressure at 17 km is about 150nb in early August, and has decreased to less than 10nb in the minimums in October. The loss rate is of the order of 1.5 percent/day. In summary, a progressive depletion in stratospheric ozone over Palmer Station was observed from August to October, 1987. Maximum depletion occurred in the 17 to 19 km range, and amounted to 95 percent. Total ozone overburden decreased by up to 50 percent during the same period. Author

**N89-14519*#** National Oceanic and Atmospheric Administration, Boulder, CO.
**TOTAL OZONE, OZONE VERTICAL DISTRIBUTIONS, AND STRATOSPHERIC TEMPERATURES AT SOUTH POLE, ANTARCTICA, IN 1986 AND 1987**
W. D. Komhyr, R. D. Grass, P. J. Reitelbach, P. R. Franchois, and S. E. Kuester (National Oceanic and Atmospheric Administration, Rockville, MD.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 45-47 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Seventy-six electrochemical cell (ECC) ozonesondes were flown at South Pole, Antarctica, during 1987 in a continuing program to document year-round changes in Antarctica ozone that are dynamically and photochemically induced. Dobson spectrophotometer total ozone observations were also made. For the twilight months of March and September when Dobson instrument observations cannot be made at South Pole, total ozone amounts were deduced from the ECC ozonesonde soundings. ECC sonde total ozone data obtained during the polar night (April to August), supplemented the sparse total ozone data obtained from Dobson instrument moon observations. Similar ozone profile and total ozone observations were made at South Pole in 1986. Author

**N89-14520*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**CORRELATION OF N2O AND OZONE IN THE SOUTHERN POLAR VORTEX DURING THE AIRBORNE ANTARCTIC OZONE EXPERIMENT**
S. E. Strahan, M. Loewenstein, J. R. Podolske, Walter L. Starr, M. H. Proffitt, K. K. Kelly (National Oceanic and Atmospheric Administration, Boulder, CO.), and K. Roland Chan *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 48-50 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

In situ N20 mixing ratios, measured by an airborne laser spectrometer (ATLAS), have been used along with in situ ozone measurements to determine the correlation of N2O and ozone in the Antarctic stratosphere during the late austral winter. During the 1987 Airborne Antarctic Ozone Experiment (AAOE), N2O data were collected by a laser absorption spectrometer on board the ER-2 on five ferry flights between Ames Research Center (37 deg N) and Punta Arenas, Chile (53 deg S), and on twelve flights over Antarctica (53 S to 72 S). Of all the trace gas species measured by instruments on board the ER-2, only one showed a relationship to the N2O/O3 correlations in the vortex. With few

exceptions, positive N20/O3 correlations coincided with total water mixing ratios of greater than 2.9 ppmv, and total water mixing ratios of less than 2.9 ppmv corresponded to negative correlations. The lower water mixing ratios, or dehydrated regions, are colocated with the negative correlations within the vortex, while the wetter regions always occur near the vortex edge. Author

**N89-14521*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**PERSISTENCE OF ANTARCTIC POLAR STRATOSPHERIC CLOUDS**
M. Patrick McCormick and C. R. Trepte (ST Systems Corp., Hampton, Va.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 53-55 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The persistence of Polar Stratospheric Clouds (PSCs) observed by the Stratospheric Aerosol Measurement (SAM) 2 satellite sensor over a 9-year period is compared and contrasted. Histograms of the SAM 2 1.0 micron extinction ratio data (aerosol extinction normalized by the molecular extinction) at an altitude of 18 km in the Antarctic have been generated for three 10-day periods in the month of September. Statistics for eight different years (1979 to 1982 and 1984 to 1987) are shown in separate panels for each figure. Since the SAM 2 system is a solar occultation experiment, observations are limited to the edge of the polar night and no measurements are made deep within the vortex where temperatures could be colder. For this reason, use is made of the NMC global gridded fields and the known temperature-extinction relationship to infer additional information on the occurrence and areal coverage of PSCs. Calculations of the daily areal coverage of the 195 K isotherm wfll be presented for this same period of data. This contour level lies in the range of the predicted temperature for onset of the Type 1 particle enhancement mode at 50 mb (Poole and McCormick, 1988b) and should indicate approximately when formation of the binary HNO3-H2O particles begins. Author

**N89-14522*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**COMPARISON OF IN SITU AEROSOL MEASUREMENTS WITH SAGE 2 AND SAM 2 AEROSOL MEASUREMENTS DURING THE AIRBORNE ANTARCTIC OZONE EXPERIMENT Abstract Only**
G. V. Ferry, M. Patrick McCormick, R. F. Pueschel, and J. M. Livingston (SRI International Corp., Menlo Park, Calif.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 56 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Models indicate that stratospheric aerosols play a major role in the destruction of ozone during the Austral winter. Although many in situ measurements of stratospheric aerosols were made during the Airborne Antarctic Ozone Experiment, changes of aerosol concentration and size distributions across the polar vortex are important to understanding changes of chemical species taking place during this time. Therefore comparing the in situ measurements with measurements made by satellites scanning wider areas will give a clearer picture of the possible role played by aerosols during this period. The wire impactor size distributions are compared to those from the aerosol spectrometers and a best fit size distribution determined. Aerosol extinctions are calculated from the in situ measurements and compared to the extinctions measured by the satellites. Five comparisons are made with SAGE 2 and four with SAM 2. Extinctions agree as close as a factor of two. Author

**N89-14523*#** Wyoming Univ., Laramie. Dept. of Physics and Astronomy.
**STRATOSPHERE AEROSOL AND CLOUD MEASUREMENTS AT MCMURDO STATION ANTARCTICA DURING THE SPRING OF 1987**
D. J. Hofmann, J. M. Rosen, and J. W. Harder *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 57-59 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Measurements of stratospheric aerosols with balloonborne optical particle counters on 6 occasions at McMurdo Station (78 deg S) in the spring of 1986 indicated subsidence of the stratospheric sulfate layer during the time that the ozone hole was forming (Hofmann et al., 1988). Since dynamic models of ozone depletion involving upwelling in the spring polar vortex would suggest the opposite, we repeated the measurements with an increased frequency (about one sounding per week) in 1987. During 3 of the aerosol soundings in 1986, temperatures in the 15 to 20 km range were low enough (less than 80 C) for HNO3 to co-condense with water according to several theories of polar stratospheric cloud formation. However, particles were not observed with the characteristic size suggested by theory (approx. 0.5 microns). For this reason, it was proposed that polar stratospheric clouds may predominantly consist of large (approx. 5 to 50 microns) ice crystals at very low (approx. 10 sup 4- 10 sup 3 cm cubed) concentrations (Rosen et al., 1988). The particle counter employed would be relatively insensitive to these low concentrations. With the increased frequency of soundings in 1987, and adding additional size discrimination in the 1 to 2 micron region, this hypothesis could be verified if suitably low temperatures were encountered. Author

**N89-14524*#** Wyoming Univ., Laramie. Dept. of Physics and Astronomy.
**BALLOON BORNE ANTARCTIC FROST POINT MEASUREMENTS AND THEIR IMPACT ON POLAR STRATOSPHERIC CLOUD THEORIES Abstract Only**
James M. Rosen, D. J. Hofmann, J. R. Carpenter, J. W. Harder, and S. J. Oltmans (National Oceanic and Atmospheric Administration, Boulder, CO.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 60 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The first balloon-borne frost point measurements over Antarctica were made during September and October, 1987 as part of the NOZE 2 effort at McMurdo. The results indicate water vapor mixing ratios on the order of 2 ppmv in the 15 to 20 km region which is somewhat smaller than the typical values currently being used significantly smaller than the typical values currently being used in polar stratospheric cloud (PSC) theories. The observed water vapor mixing ratio would correspond to saturated conditions for what is thought to be the lowest stratospheric temperatures encountered over the Antarctic. Through the use of available lidar observations there appears to be significant evidence that some PSCs form at temperatures higher than the local frost point (with respect to water) in the 10 to 20 km region thus supporting the nitric acid theory of PSC composition. Clouds near 15 km and below appear to form in regions saturated with respect to water and thus are probably mostly ice water clouds although they could contain relatively small amounts of other constituents. Photographic evidence suggests that the clouds forming above the frost point probably have an appearance quite different from the lower altitude iridescent, colored nacreous clouds. Author

**N89-14525*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**LARGE-SCALE VARIATIONS IN OZONE AND POLAR STRATOSPHERIC CLOUDS MEASURED WITH AIRBORNE LIDAR DURING FORMATION OF THE 1987 OZONE HOLE OVER ANTARCTICA**
Edward V. Browell, Lamont R. Poole, M. Patrick McCormick, Syed Ismail, Carolyn F. Butler, Susan A. Kooi, Margaret M. Szedlmayer, Rod Jones, Arlin J. Krueger, and Adrian Tuck (National Oceanic and Atmospheric Administration, Boulder, CO.) *In its* Polar Ozone Workshop. Abstracts May 1988 p 61-64 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

A joint field experiment between NASA and NOAA was conducted during August to September 1987 to obtain in situ and

remote measurements of key gases and aerosols from aircraft platforms during the formation of the ozone (O3) hole over Antarctica. The ER-2 (advanced U-2) and DC-8 aircraft from the NASA Ames Research Center were used in this field experiment. The NASA Langley Research Center's airborne differential absorption lidar (DIAL) system was operated from the DC-8 to obtain profiles of O3 and polar stratospheric clouds in the lower stratosphere during long-range flights over Antarctica from August 28 to September 29, 1987. The airborne DIAL system was configured to transmit simultaneously four laser wavelengths (301, 311, 622, and 1064 nm) above the DC-8 for DIAL measurements of O3 profiles between 11 to 20 km ASL (geometric altitude above sea level) and multiple wavelength aerosol backscatter measurements between 11 to 24 km ASL. A total of 13 DC-8 flights were made over Antarctica with 2 flights reaching the South Pole. Polar stratospheric clouds (PSC's) were detected in multiple thin layers in the 11 to 21 km ASL altitude range with each layer having a typical thickness of less than 1 km. Two types of PSC's were found based on aerosol backscattering ratios: predominantly water ice clouds (type 2) and clouds with scattering characteristics consistent with binary solid nitric acid/water clouds (type 1). Large-scale cross sections of O3 distributions were obtained. The data provides additional information about a potentially important transport mechanism that may influence the O3 budget inside the vortex. There is also some evidence that strong low pressure systems in the troposphere are associated with regions of lower stratospheric O3. This paper discusses the spatial and temporal variations of O3 inside and outside the polar vortex region during the development of the O3 hole and relates these data to other measurements obtained during this field experiment. Author

**N89-14526*#** National Center for Atmospheric Research, Boulder, CO.

**FILTER MEASUREMENTS OF CHEMICAL COMPOSITION DURING THE AIRBORNE ANTARCTIC OZONE EXPERIMENT Abstract Only**

B. W. Grandrud, P. D. Sperry, and L. Sanford *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 65 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

During the Airborne Antarctic Ozone Experiment campaign, a filter sampler was flown to measure the bulk composition of aerosol and gas phases. The background sulfate aerosol was measured in regions inside and outside of the chemically perturbed region (CPR) of the polar vortex. The mass ratio of sulfate outside to inside was 2.8. This is indicative of a cleansing mechanism effecting the CPR or of a different air mass inside versus outside. The absolute value of the sulfate mixing ratio shows that the background aerosol has not been influenced by recent volcanic eruptions. The sulfate measured on the ferry flight returning to NASA Ames shows a decrease towards the equator with increasing concentrations in the northern hemisphere. Nitrate in the aerosol phase was observed on two flights. The largest amount of nitrate measured in the aerosol was 44 percent of the total amount of nitrate observed. Other samples on the same flights show no nitrate in the aerosol phase. The presence of nitrate in the aerosol is correlated with the coldest temperatures observed on a given flight. Total nitrate (aerosol plus acidic vapor nitrate) concentrations were observed to increase at flight altitude with increasing latitude north and south of the equator. Total nitrate was lower inside the CPR than outside. Chloride and flouride were not detected in the aerosol phase. From the concentrations of acidic chloride vapor, the ratio of acidic vapor Cl to acidic vapor F and a summing of the individual chloride containing species to yield a total chloride concentration, there is a suggestion that some of the air sampled was dechlorinated. Acidic vapor phase fluoride was observed to increase at flight altitude with increasing latitude both north and south of the equator. The acidic vapor phase fluoride was the only compound measured with the filter technique that exhibited larger concentrations inside the CPR than outside. Author

**N89-14527*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**ANTARCTIC POLAR STRATOSPHERIC AEROSOLS: THE ROLES OF NITRATES, CHLORIDES AND SULFATES Abstract Only**

R. F. Pueschel, K. G. Snetsinger, J. K. Goodman, G. V. Ferry, V. R. Oberbeck, S. Verma, and W. Fong (Information Management International, Inc., Palo Alto, CA.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 66 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Nitric and hydrochloric acids have been postulated to condense in the winter polar stratosphere to become an important component of polar stratospheric clouds. One implication is that the removal of NO(y) from the gas phase by this mechanism allows high Cl(x) concentrations to react with O3, because the formation of ClNO3 is inhibited. Contributions of NO3 and Cl to the stratospheric aerosol were determined during the 1987 Airborne Antarctic Ozone Experiment by testing for the presence of nitrates and chlorides in the condensed phase. Aerosol particles were collected on four 500 micron diameter gold wires, each pretreated differently to give results that were specific to certain physical and chemical aerosol properties. One wire was carbon-coated for concentration and size analyses by scanning electron microscopy; X-ray energy dispersive analyses permitted the detection of S and Cl in individual particles. Three more wires were coated with Nitron, barium chloride and silver nitrate, respectively, to detect nitrate, sulfate and chloride in aerosol particles. All three ions, viz., sulfates, nitrates and chlorides were detected in the Antarctic stratospheric aerosol. In terms of number concentrations, the aerosol was dominated by sulfates, followed by chlorides and nitrates. An inverse linear regression can be established between nitrate concentrations and ozone mixing ratio, and between temperature and nitrates.

Author

**N89-14528*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**ON THE SIZE AND COMPOSITION OF PARTICLES IN POLAR STRATOSPHERIC CLOUDS**

Stefan Kinne, Owen B. Toon, Goeff C. Toon, Crofton B. Farmer, and Edward V. Browell (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 67-70 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Attenuation measurements of the solar radiation between 1.5 and 15 micron wavelengths were performed with the airborne (DC-8) JPL MARK 4 interferometer during the 1987 Antarctic Expedition. The opacities not only provide information about the abundance of stratospheric gases but also about the optical depths of polar stratospheric clouds (PSCs) at wavelengths of negligible gas absorption (windows). The optical depth of PSCs can be determined for each window once the background attenuation, due to air-molecules and aerosol has been filtered out with a simple extinction law. The ratio of optical thicknesses at different wavelengths reveals information about particle size and particle composition. Among the almost 700 measured spectra only a few PSC cases exist. PSC events are identified by sudden reductions in the spectrally integrated intensity value and are also verified with backscattering data from an upward directed lidar instrument, that was mounted on the DC-8. For the selected case on September 21st at 14.40 GMT, lidar data indicate an optically thin cloud at 18k and later an additional optically thick cloud at 15 km altitude. All results still suffer from: (1) often arbitrary definitions of a clear case, that often already may have contained PSC particles and (2) noise problems that restrict the calculations of optical depths to values larger than 0.001. Once these problems are handled, this instrument may become a valuable tool towards a better understanding of the role PSCs play in the Antarctic stratosphere. Author

**N89-14529*#** Aquila Univ. (Italy). Dipartimento di Fisica.
**FORMATION OF POLAR STRATOSPHERIC CLOUDS SIMULATED IN A TWO DIMENSIONAL MODEL OF THE ATMOSPHERE Abstract Only**
Guido Visconti and Giovanni Pitari *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 71 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

A microphysics code has been implemented in a two dimensional model of the atmosphere to study formation of polar stratospheric clouds containing HCl or HNO3. The model range is from pole to pole in latitude and from the ground to about 20 km in altitude. Resolution in latitude is 10 deg and about 0.8 km in altitude. This is an Eulerian model with prescribed eddy diffusion coefficients and the circulation obtained from observations. The chemistry of the model follows the family approach for NO(x), Cl(x) and HO(x) while the ozone is fixed and changed seasonally. The aerosol code is based on an assigned population of condensation, coagulation and sedimentation. Aerosol growth is simulated in nine different size bins ranging between 0.01u and 2.56u. The model has been built to study aerosol layers formation in the upper troposphere and lower stratosphere and has been validated for sulfate aerosol resulting from a rather complex sulfur chemistry. Author

**N89-14530*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**ICE IN THE ANTARCTIC POLAR STRATOSPHERE**
J. K. Goodman (San Jose State Univ., Calif.), B. Toon, R. F. Pueschel, K. G. Snetsinger, and S. Verma *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 72 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

On six occasions during the 1987 Airborne Antarctic Ozone Experiment, the Polar Stratospheric Cloud (PSC) ice crystals were replicated over the Palmer Peninsula at approximately 70 deg South. The sampling altitude was approximately 60 to 65 thousand feet, the temperature range was -83.5 to -72C and the atmosphere was subsaturated in all cases. The collected crystals were predominantly complete and hollow prismatic columns with maximum dimensions up to 217 microns. Evidence of scavenging of submicron particles was detected on several crystals. While the replicated crystal sizes were larger than anticipated, their relatively low concentration results in a total surface area less than one tenth that of the sampled aerosol particles. The presence of large crystals suggest that PSC ice crystals can play a very important role in stratospheric dehydration processes. Author

**N89-14531*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**IN-SITU MEASUREMENTS OF TOTAL REACTIVE NITROGEN, TOTAL WATER VAPOR, AND AEROSOLS IN POLAR STRATOSPHERIC CLOUDS IN THE ANTARCTIC STRATOSPHERE Abstract Only**
D. W. Fahey, K. K. Kelly, G. V. Ferry, L. R. Poole, J. C. Wilson, D. M. Murphy (National Oceanic and Atmospheric Administration, Boulder, CO.), and K. Roland Chan *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 75-76 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Measurements of total reactive nitrogen, NOy, total water vapor, and aerosols were made as part of the Airborne Antarctic Ozone Experiment. The measurements were made using instruments located onboard the NASA ER-2 aircrafts which conducted twelve flights over the Antarctic continent reaching altitudes of 18 km at 72 S latitude. Each instrument utilized an ambient air sample and provided a measurement up to 1 Hz or every 200 m of flight path. The data presented focus on the flights of Aug. 17th and 18th during which Polar Stratospheric Clouds (PSCs) were encountered containing concentrations of 0.5 to 1.0 micron diameter aerosols greater than 1 cm/cu. The temperature pressure during these events ranged as low as 184 K near 75 mb pressure, with water values near 3.5 ppm by volume (ppmv). With the exception of two short periods, the PSC activity was observed at temperatures above the frost point of water over ice. The data gathered during these flights are analyzed and presented. Author

**N89-14532*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**EXTINCTION AND BACKSCATTER MEASUREMENTS OF ANTARCTIC PSC's, 1987: IMPLICATIONS FOR PARTICLE AND VAPOR REMOVAL**
L. R. Poole, M. Patrick McCormick, Edward V. Browell, C. R. Trepte, D. W. Fahey, K. K. Kelly, G. V. Ferry, R. F. Pueschel, and R. L. Jones (Meteorological Office, Bracknell, England ) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 77-79 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The temperature dependence is examined of optical properties measured in the Antarctic during 1987 at the 70 mb level (near 18 km), a level chosen to correlate the results with in situ measurements made from the NASA-Ames ER-2 aircraft during the 1987 Airborne Antarctic Ozone Experiment (AAOE). The data set consists of extinction measurements by Sam 2 inside the Antarctic polar vortex from May to October 1987; and backscatter measurements by the UV-DIAL (Ultraviolet Differential Absorption Lidar) system aboard the Ames DC-8 aircraft during selected AAOE flights. Observed trends are compared with results from a revised version of Pole and McCormick's model to classify the PSC observations by Type (1 or 2) and infer the temporal behavior of the ambient aerosol and ambient vapor mixing ratios. The sample figures show monthly ensembles of the 70-mb Sam 2 extinction ratio (the ratio of aerosol or PSC extinction to molecule extinction) as a function of NMC temperature at the beginning (June) and (October) of the 1987 Antarctic winter. Both ensembles show two rather distinct clusters of points: one oriented in the near vertical direction which depicts the change with temperature of the ambient aerosol extinction ratio; and a second cluster oriented in the near horizontal direction whose position on the vertical scale marks a change in particle phase (i.e., PSC formation) and whose length (the extinction enhancement related to that of the ambient aerosol) is an indicator of PSC type. Author

**N89-14533*#** Minnesota Univ., Minneapolis.
**LABORATORY STUDIES OF HNO3/H2O MIXTURES AT LOW TEMPERATURES**
David Hanson and Konrad Mauersberger *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 80-82 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The possibility of stratospheric HN3 condensing out of the gas-phase at low temperatures has become important in the chemical explanations of the rapid loss of Antarctic ozone in spring. Consequently, knowledge about the behavior of the vapor pressures of water and HNO3 over HNO3/water mixtures at stratospheric temperatures is needed to determine if HNO3 could condense, and by how much the HNO3 vapor pressure could be depressed. Laboratory investigations of vapor pressures above HNO3/water mixtures are described. Vapor pressures were initially measured over liquid and frozen bulk mixtures contained in a glass still which was attached to a stainless steel vacuum chamber. The total pressure in the chamber was monitored with a precision pressure sensor, and the vapor pressures of HNO3, water and impurities were analyzed with a mass spectrometer beam system. In a second set of experiments, vapor deposits were made to produce ice and the mono- and trihydrate of HNO3. Further data and conclusions are presented. Author

**N89-14534*#** Princeton Univ., N. J. Atmospheric and Ocean Sciences Program.
**EVOLUTION OF POLAR STRATOSPHERIC CLOUDS DURING THE ANTARCTIC WINTER Abstract Only**
V. Ramaswamy *In* NASA, Goddard Space Flight Center, Polar

Ozone Workshop. Abstracts May 1988 p 83-84 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The occurrence of Polar Stratospheric Clouds (PSCs), initially inferred from satellite measurements of solar extinction, have now also been noted by the recent scientific expeditions in the Antarctic. The presence of such clouds in the Antarctic has been postulated to play a significant role in the depletion of ozone during the transition from winter to spring. The mechanisms suggested involve both dynamical and chemical processes which, explicity or implicitly, are associated with the ice particles constituting the PSCs. It is, thus, both timely and necessary to investigate the evolution of these clouds and ascertain the nature and magnitude of their influences on the state of the Antarctic stratosphere. To achieve these objectives, a detailed microphysical model of the processes governing the growth and sublimation of ice particles in the polar stratosphere was developed, based on the investigations of Ramaswamy and Detwiler. The present studies focus on the physical processes that occur at temperatures below those required for the onset of ice deposition from the vapor phase. Once these low temperatures are attained, the deposition of water vapor onto nucleation particles becomes extremely significant. First, the factors governing the magnitude of growth and the growth rate of ice particles at various altitudes are examined. Second, the ice phase mechanisms are examined in the context of a column model with altitudes ranging from 100 to 5 mb pressure levels. The column microphysical model was used to perform simulations of the cloud evolution, using the observed daily temperatures. The effect due to the growth of the particles on the radiation fields are also investigated using a one dimensional radiative transfer model. Specifically, the perturbations in the longwave cooling and that in the shortwave heating for the late winter/early spring time period are analyzed. Author

**N89-14535*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**HETEROGENEOUS PHYSICOCHEMISTRY OF THE WINTER POLAR STRATOSPHERE**

R. P. Turco (R and D Associates, Marina Del Rey, Calif.) and O. B. Toon *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 85-89 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Present chemical theories of the Antarctic ozone hole assume that heterogeneous reactions involving polar stratospheric clouds (PSCs) are the precursor of springtime ozone depletions. However, none of the theories quantify the rates of proposed heterogeneous processed, and none utilize the extensive data base on PSC's. Thus, all of the theories must be considered incomplete until the heterogeneous mechanisms are properly defined. A unified treatment developed of the cloud related processes, both physical and chemical, and the importance of these processes using observation data is calibrated. The rates are compared competitive heterogeneous processes to place reasonable limits on critical mechanisms such as the denitrification and dechlorination of the polar winter stratosphere. Among the subjects addressed here are the physical/chemical properties of PSC's including their relevant microphysical, optical and compositional characteristics, mass transfer rates of gaseous constituents to cloud particles, adsorption, accommodation and sticking coefficients on cloud particles, time constants for condensation, absorption and other microphysical processes, effects of solubility and vapor pressure on cloud composition, the statistics of cloud processing of chemically active condensible species, rate limiting steps in heterogeneous chemical reactions, and the nonlinear dependence of ozone loss on physical and chemical parameters. Author

**N89-14536*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**PHYSICAL PROCESSES IN POLAR STRATOSPHERIC ICE CLOUDS**

Owen B. Toon, Richard Turco, and Joseph Jordan (Sterling, Walter V., Inc., Palo Alto, Calif ) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 90-94 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

A one dimensional model of cloud microphysics was used to simulate the formation and evolution of polar stratospheric ice clouds. Some of the processes which are included in the model are outlined. It is found that the clouds must undergo preferential nucleation upon the existing aerosols just as do tropospheric cirrus clouds. Therefore, there is an energy barrier between stratospheric nitric acid particles and ice particles implying that nitric acid does not form a continuous set of solutions between the trihydrate and ice. The Kelvin barrier is not significant in controlling the rate of formation of ice particles. It was found that the cloud properties are sensitive to the rate at which the air parcels cool. In wave clouds, with cooling rates of hundreds of degrees per day, most of the existing aerosols nucleate and become ice particles. Such clouds have particles with sizes on the order of a few microns, optical depths on order of unity and are probably not efficient at removing materials from the stratosphere. In clouds which form with cooling rates of a few degrees per day or less, only a small fraction of the aerosols become cloud particles. In such clouds the particle radius is larger than 10 microns, the optical depths are low and water vapor is efficiently removed. Seasonal simulations show that the lowest water vapor mixing ratio is determined by the lowest temperature reached, and that the time when clouds disappear is controlled by the time when temperatures begin to rise above the minimum values. Author

**N89-14537*#** SRI International Corp., Menlo Park, Calif. Dept. of Chemical Kinetics.

**HETEROGENEOUS CHEMISTRY RELATED TO ANTARCTIC OZONE DEPLETION: REACTION OF ClONO2 AND N2O5 ON ICE SURFACES**

Margaret A. Tolbert, Michel J. Rossi, and David M. Golden (Sterling, Walter V., Inc., Palo Alto, Calif ) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 95-97 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Laboratory studies of heterogeneous reactions of possible importance for Antarctic ozone depletion were performed. In particular, the reactions of chlorine nitrate (ClONO2) and dinitrogen pentoxide (N2O5) were investigated on ice and HCl/ice surfaces. These reactions occur on the surfaces of polar stratospheric clouds (PSCs) over Antarctica. One reaction transforms the stable chlorine reservoir species (ClONO2 and HCl) into photochemically active chlorine in the form of HOCl and Cl2. Condensation of HNO3 in the reactions removes odd nitrogen from the stratosphere, a requirement in nearly all models of Antarctic ozone depletion. Other reactions may also be important for Antarctic ozone depletion. Like the reactions of chlorine nitrate, these reactions deplete odd nitrogen through HNO3 condensation. In addition, one reaction converts a stable chlorine reservior species (HCl) into photochemically active chlorine (ClNO2). These reactions were studied with a modified version of a Knudsen cell flow reactor. Author

**N89-14538*#** Aerodyne Research, Inc., Billerica, MA. Dept. of Chemical Kinetics.

**MASS ACCOMMODATION COEFFICIENT MEASUREMENTS FOR HNO3, HCl AND N2O5 ON WATER, ICE AND AQUEOUS SULFURIC ACID DROPLET SURFACES**

Douglas Worsnop, Mark Zahniser, Charles Kolb, Lyn Watson, Jane VanDoren, John Jayne, and Paul Davidovits (Boston Coll., Chestnut Hill, MA.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 98-100 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Preliminary results are reported of the direct measurement of accommodation coefficients for HNO3, N2O5 and HCl on water drops, aqueous sulfuric acid drops and ice particles. The heterogeneous chemistry of these species together with ClONO2 has been implicated in the ozone depletion observed in the Antarctic stratosphere during the spring in the last eight years.

The most plausible chemical mechanism involves the removal of nitrogen oxide species via condensation on ice particles in polar stratospheric clouds resulting in a increase in the active chlorine species responsible for the ozone depletion. The observation of low NO2 and high ClO densities in the Antarctic stratosphere last summer appear to be consistent with such a mechanism. Author

**N89-14539*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**LABORATORY STUDIES OF STICKING COEFFICIENTS AND HETEROGENEOUS REACTIONS IMPORTANT IN THE STRATOSPHERE**

Ming-Taun Leu *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 102-103 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

The discovery of ozone depletion during spring in the Antarctic stratósphere has received wide spread attention. Both meteorological and chemical mechanisms have been used in attempts to explain this observation. The chemical theory focused on the chlorofluoromethanes released into the atmosphere. However, gas-phase, homogeneous reactions alone in the model can not adequately explain such a depletion. Heterogeneous reactions on ice surfaces could be important in the Antarctic stratosphere. These reactions are thought to convert ClONO2 and N2O5 into HNO3 in the solid phase while Cl2, HOCl, and ClNO2 are released into the stratosphere as gas-phase products. The photolysis of Cl2, HOCl, and ClNO2, then produces active chlorine which subsequently removes ozone through several catalytic cycles, including the Cl2O2 mechanism. The polar stratospheric clouds are thought to consist of mixtures of water ice, nitric acid, and sulfuric acid. Condensation of HCl onto the PSC's could provide active surfaces for heterogeneous reactions. Author

**N89-14540*#** SRI International Corp., Menlo Park, Calif.

**LIDAR OBSERVATIONS OF POLAR STRATOSPHERIC CLOUDS AT MCMURDO, ANTARCTICA, DURING NOZE-2**

Bruce M. Morley *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 104-107 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

SRI International operated a dual wavelength (1.064 micrometer and .532 micrometer) aerosol lidar at McMurdo Station, Antarctica, as part of the National Ozone Expedition-2 (NOZE-2). The objective of the project was to map the vertical distributions of polar stratospheric clouds (PSCs), which are believed to play an important role in the destruction of ozone in the Antarctic spring. Altitude, thickness, homogeneity, and duration of PSC events as well as information on particle shape, size or number density will be very useful in determining the exact role of PSCs in ozone destructions, and when combined with measurements of other investigators, additional properties of PSCs can be estimated. The results are currently being analyzed in terms of PSC properties which are useful for modeling the stratospheric ozone depletion mechanism. Author

**N89-14541*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**OBSERVATIONS OF CONDENSATION NUCLEI IN THE 1987 AIRBORNE ANTARCTIC OZONE EXPERIMENT**

J. C. Wilson, S. D. Smith (Aerosystems, Saint Paul, MN.), G. V. Ferry, and M. Loewenstein *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 108-112 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

The condensation nucleus counter (CNC) flown of the NASA ER-2 in the Airborne Antarctic Ozone Experiment provides a measurement of the number mixing ratio of particles which can be grown by exposure to supersaturated n-butyl alcohol vapor to diameters of a few microns. Such particles are referred to as condensation nuclei (CN). The ER-2 CNC was calibrated with aerosols of known size and concentration and was found to provide an accurate measure of the number concentration of particles larger than about 0.02 micron. Since the number distribution of stratospheric aerosols is usually dominated by particles less than a few tenths of micron in diameter, the upper cutoff of the ER-2 CNC has not been determined experimentally. However, theory suggests that the sampling and counting efficiency should remain near one for particles as large as 1 micron in diameter. Thus, the CN mixing ratio is usually a good measure of the mixing ratio of submicron particles. Author

**N89-14542*#** Department of Scientific and Industrial Research, Lauder (New Zealand).

**STRATOSPHERIC COLUMN NO2 MEASUREMENTS FROM THREE ANTARCTIC SITES**

J. G. Keys and P. V. Johnston *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 115-117 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

The significance of stratospheric odd-nitrogen compounds in Antarctic ozone depletion studies has prompted an increase in Antarctic activities. Although several species are being studied, work has concentrated on the acquisition of NO2 data. Ground-based measurements of stratospheric column NO2 have been made at Arrival Heights, Antarctica, since spring 1982, with some gaps in the data base. Additional data has been acquired since February 1986 at Pole Station and Halley Bay, thus providing a chain of stations across the continent. The technique used is that of absorption spectroscopy in several wavelength regions, although here only those measurements are reported in the 430 to 450 nm region where strongly structured absorption been determined experimentally. However, theory features due to NO2 are identified in scattered sunlight in the zenith sky. Operation of a moon-tracking system at Arrival Heights has provided some additional data during the polar night. Previous analyses have shown that the NO2 column observed from the ground is strongly influenced by the season, and by the location of the site with respect to that of the polar vortex. The column amount correlates strongly with stratospheric temperature at about 70 mbar. The present data set further illustrates these features, and demonstrates both the strengths and qualifications apparent in the technique. Author

**N89-14543*#** National Oceanic and Atmospheric Administration, Boulder, CO. Aeronomy Lab.

**GROUND-BASED MEASUREMENTS OF O3, NO2, OClO, AND BrO DURING THE 1987 ANTARCTIC OZONE DEPLETION EVENT**

R. W. Sanders, S. Solomon, M. A. Carroll, and A. L. Schmeltekopf *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 118 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Near-ultraviolet absorption spectroscopy in the wavelength range from 330 to 370 nm was used to measure O3, NO2, OClO, and BrO at McMurdo Station (78S) during 1987. Visible absorption measurements of O3, NO2, and OClO were also obtained using the wavelength range from about 403 to 453 nm. These data are described and compared to observations obtained in 1986. It is shown that comparisons of observations in the two wavelength ranges provide a sensitive measure of the altitude where the bulk of atmospheric absorption takes place. Author

**N89-14544*#** National Oceanic and Atmospheric Administration, Boulder, CO. Aeronomy Lab.

**NEAR UV ATMOSPHERIC ABSORPTION MEASUREMENTS FROM THE DC-8 AIRCRAFT DURING THE 1987 AIRBORNE ANTARCTIC OZONE EXPERIMENT Abstract Only**

A. Wahner, R. O. Jakoubek (Colorado Univ., Boulder.), A. R. Ravishankara, G. H. Mount, and A. L. Schmeltekopf *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 119 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01

During the Airborne Antarctic Ozone Experiment from 28 August

to 30 September 1987 near UV zenith scattered sky measurements were made over Antarctic from the NASA DC-8 aircraft using a one third m spectrograph equipped with a diode-array detector. Scattered sky light data in the wavelength range 348 nm to 388 nm was spectrally analyzed for O3, NO2, OClO, and BrO column abundances. Slant column abudances of O3, NO2, OClO and BrO were determined, using a computer algorithm of non-linear and linear least square correlation of Antarctic scattered sky spectra to laboratory absorption cross section data. Using measured vertical electrochemical sonde ozone profiles from Palmer, Halley Bay, and the South Pole Stations the slant columns of O3 were converted into vertical column abundances. The vertical column amounts of NO2, OClO, and BrO were derived using vertical profiles calculated by a chemical model appropriate for Antarctica. NO2 vertical column abundances show steep latitudinal decrease with increasing latitude for all 13 flights carried out during the mission. In the regions where NO2 abudances are low, OClO and BrO were observed. The spatial and temporal vertical column abundances of these species are discussed in the context of the chemistry and dynamics in the antarctic polar vortex during the austral spring. Author

**N89-14545*#** National Center for Atmospheric Research, Boulder, CO.

**INFRARED MEASUREMENTS OF COLUMN AMOUNTS OF STRATOSPHERIC CONSTITUENTS IN THE ANTARCTIC WINTER, 1987**

William G. Mankin and M. T. Coffey *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 120-123 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

The discovery of Farman et al. of recent large depletions of ozone in the Antarctic stratosphere in the austral spring has aroused great interest because of its serious potential consequences, as well as its surprising nature. An airborne expedition, including 21 experiments on two aircraft, was mounted for Punta Arenas, Chile, in August and September, 1987, to gather a wide range of data to understand the origins and implications of this phenomenon, known as the ozone hole. As a part of this expedition, a high resolution Fourier transform spectrometer was flown on the DC-8, measuring the column amount of a number of trace gases above the flight altitude. Column results are presented only from the flight of September 21; results from other flights are included in an accompanying paper. The deduced column for ozone HCl, and NO2 deduced from the spectra, plotted as a function of latitude are shown. It should be noted that there are many other factors varying as well as the latitude, but latitude seems to be the variable which most clearly provides a passage across the vortex boundary. It can be seen that south 76 degrees S., the column of ozone, HCl, and NO2, all decreas markedly, The ratio of HCl to Hf, normally about 5:1 in midlatitudes, approaches unity. Clearly the chemistry of chlorine and nitrogen are disturbed in the region of low ozone. While dynamical theories could perhaps explain a reduction of these three gases in the same region, since all are of stratospheric origin, it is difficult to see how any purely dynamical mechanism could produce the observed HCl:HF ratio, since the two gases have similar origins. A close look at other species to be reported as well as the correlation with other measurements, such as ClO supports the conclusion that the ozone depletion is a result of chemical processes which deplete HCl and NOx relative to the midlatitude situation. Author

**N89-14546*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**INFRARED AIRCRAFT MEASUREMENTS OF STRATOSPHERIC COMPOSITION OVER ANTARCTICA DURING SEPTEMBER 1987 Abstract Only**

Goeff C. Toon, C. B. Farmer, L. L. Lowes, P. W. Schaper, J.-F. Blavier, and R. H. Norton *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 124 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

The JPL Mark IV interferometer recorded high resolution, infared solar spectra from the NASA DC-8 aircraft during flights over Antarctica in September 1987. The atmospheric absorption features in these spectra were analyzed to determine the overburdens of O3, NO, NO2, HNO3, ClONO2, HCl, HF, CH4, N2O, CO, H2O and CFC-12. The spectra were obtained at latitudes which ranged between 64 degrees S and 86 degrees S, allowing the composition in the interior of the polar vortex to be compared with that at the edge. The latitude dependence observed for NO, HO2, HNO3, ClONO2, HCl and HF are summerized. The values at 30 deg S were observed on the ferry flight from New Zealand to Hawaii. The dashed lines connecting the two were interpolated across the region for which there are no measurements. The chemically perturbed region is seen to consist of a collar of high HNO3 and ClONO2 surrounding a core in which the overburdens of these and of HCl and NO2 are very low. Clear increases in the overburdens of HF and HNO3 were observed during the course of September in the vortex core. HCl and NO2 exhibited smaller, less significant increases. The overburdens of the tropospheric source gases, N2O, CH4, CF2Cl2, and H2O were observed to much smaller over Antarctica than at mid-latitudes. This, together with the fact that HF over Antarctica was more that double its mid-latitude value, suggests that downwelling has occurred. Author

**N89-14547*#** Denver Univ., CO. Dept. of Physics.

**INFRARED MEASUREMENTS IN THE SPRING 1987 OZONE HOLE Abstract Only**

F. J. Murcray, D. G. Murcray, Aaron Goldman, J. G. Keys, and W. A. Matthews (Department of Scientific and Industrial Research, Lauder, New Zealand ) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 125-126 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Solar spectra were recorded from Arrival Heights (McMurdo), Antartica, with a FTIR system during the austral spring of 1987. Spectra were recorded on 22 days from September 13 through October 28. The instrument was setup with 2 detectors for simultaneous operation in 2 wavelength regions. Several stratospheric gases have measurable absorptions in these regions including HCl, HNO3, O3, ClONO2, and NO2. The system is equipped with an automatic solar tracking system and records data on tape cartridges. A portable personal computer allows Fourier transforming and initial processing of some of the data. The HNO3 gas column amount shows large variations, but no apparent correlation with stratospheric temperature. The HCl column shows a steady increase from 0.9 x 10 to the 15th power molecules/sq.cm. on September 13 to 1.5 x 10 to the 15th power on October 6. McMurdo moved out of the polar vortex for a few days, and the HCl column jumped to 2.9 x 10 to the 15th power by October 11. Although McMurdo moved back under the vortex, the HCl continued to increase, reaching 3.4 x 10 to the 15th power at the end of the period. Author

**N89-14548*#** State Univ. of New York, Stony Brook.

**QUANTITATIVE OBSERVATIONS OF THE BEHAVIOR OF ANOMALOUS LOW ALTITUDE ClO IN THE ANTARCTIC SPRING STRATOSPHERE, 1987**

R. L. deZafra, M. Jaramillo, J. Barrett, L. Emmons, P. Solomon, and A. Parrish *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 127-130 Prepared in cooperation with Millitech Corp., South Deerfield, MA (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

During the second National Ozone Expedition ground-based observations at McMurdo Station Antarctica were performed which resulted in a second season's measurement of abnormally large amounts of ClO in the Antarctic spring stratosphere. The original measurements of 1986, in which the presence of this anomalous layer was first discovered, were limited in low altitude recovery of the ClO mixing ratio profile by the restrictions of the spectral bandwidth (256 MHz) which was used to measure the pressure-broadened ClO emission line shape. The 1987 measurements were marked by the use of twice the spectral

bandpass employed the previous year, and allow a better characterization of the ClO mixing ratio profile in the critical altitude range 18 to 25 km. In-situ aircraft measurements of ClO made over the Palmer Peninsula during Aug. and Sept. of 1987 by Anderson, et al. effectively determined the important question of the ClO mixing ratio profile at altitudes inaccessible to our technique, below approximately 18 to 18.5 km. These flights did not penetrate further than 75 deg S, however, (vs 78 deg S for McMurdo) and were thus limited to coverage near the outer boundaries of the region of severest ozone depletion over Antarctica in 1987, did not reach an altitude convincingly above that of the peak mixing ratio for ClO, and were not able to make significant observations of the diurnal variation of ClO. The two techniques, and the body of data recovered by each, thus complement one another in producing a full picture of the anomalous ClO layer intimately connected with the region of Antarctic spring ozone depletion. An analysis is presented of the mixing ratio profile from approximately 18 to 45 km, the diurnal behavior, and the secular change in ClO over McMurdo Station during Sept. and early Oct. 1987. Author

**N89-14549*#** State Univ. of New York, Stony Brook.
**DAYTIME ClO OVER MCMURDO IN SEPTEMBER 1987: ALTITUDE PROFILE RETRIEVAL ACCURACY**
J. Barrett, P. Solomon, M. Jaramillo, R. L. deZafra, A. Parrish, and L. Emmons *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 131-134 Prepared in cooperation with Millitech Corp., South Deerfield, MA (For primary document see N89-14503 06-45)
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During the 1987 National Ozone Expedition, mm-wave emission line spectra of the 278.6 GHz rotational stratospheric ClO were observed at McMurdo Station, Antarctica. The results confirm the 1986 discovery of a lower stratospheric layer with approximately 100 times the normal amount of ClO; the 1987 observations, made with a spectrometer bandwidth twice that used in 1986, make possible a more accurate retrieval of the altitude profile of the low altitude component of stratospheric ClO from the pressure broadened line shape, down to approximately 16 km. The accuracy of the altitude profile retrievals is discussed, using the daytime (09:30 to 19:30, local time) data from 20 to 24 September, 1987 as an example. The signal strength averaged over this daytime period is approx. 85 percent of the midday peak value. The rate of ozone depletion implied by the observed ClO densities is also discussed. Author

**N89-14550*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**AN FTIR SPECTROMETER FOR REMOTE MEASUREMENTS OF ATMOSPHERIC COMPOSITION Abstract Only**
C. B. Farmer, P. W. Schaper, Goeff C. Toon, J.-F. Blavier, G. Mohler, and D. Petterson *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 135 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The JPL IV interferometer, and infrared Michelson interferometer, was built specifically for recording high resolution solar absorption spectra from remote ground-based sites, aircraft and from stratospheric balloons. The instrument is double-passed, with one fixed and one moving corner reflector, allowing up to 200-cm of optical path difference (corresponding to an unapodised spectral resolution of 0.003/cm). The carriage which holds the moving reflector is driven by a flexible nut riding on a lead screw. This arrangement, together with the double-passed optical scheme, makes the instrument resistant to the effects of mechanical distortion and shock. The spectral range of the instrument is covered by two liquid nitrogen-cooled detectors: an InSb photodiode is used for the shorter wavelengths (1.85 to 5.5 microns, 1,800 to 5,500/cm) and a HgCdTe photoconductor for the range (5.5 to 15 microns, 650 to 1,800/cm). For a single spectrum of 0.01/cm resolution, which requires a scan time of 105 seconds, the signal/noise ratio is typically 800:1 over the entire wavelength range. Author

**N89-14551*#** National Center for Atmospheric Research, Boulder, CO.
**TEMPORAL AND SPATIAL DISTRIBUTION OF STRATOSPHERIC TRACE GASES OVER ANTARCTICA IN AUGUST AND SEPTEMBER, 1987**
M. T. Coffey and William G. Mankin *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 136-137 Sponsored in part by NSF (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

There have been a large number of suggestions made concerning the origin of the Antarctic 'ozone hole' since its discovery; these changes include stratospheric chemistry, or changes in the solar input, or combinations of these effects. Supporting or refuting these theories requires a wide variety of data for comparison with the predictions. In Aug. and Sept., 1987, a field observation expedition was made over Antarctica from a base in Punta Arenas, Chile. Two aircraft, an ER-2 with in-situ instruments flew at altitudes up to 18 km measuring ozone, water, ClO, BrO, NO sub x, particles, and meteorological parameters in the ozone layer. A DC-8 flew at altitudes of 10 to 12 km, below the ozone layer, using remote sensing instruments for measuring composition and aerosol content of the ozone layer, as well as in-situ instruments for measuring composition at aircraft altitudes. The obsevation of a number of chemical species and their correlation with each other and with meteorological parameters gives a useful set of data for comparison with various theories. Author

**N89-14552*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**MEASUREMENTS OF OZONE IN THE ANTARCTIC REGION DURING AUGUST AND SEPTEMBER OF 1987 Abstract Only**
Walter L. Starr and James F. Vedder *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 138 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Mixing ratios are presented for ozone in the austral polar atmosphere during Aug. and Sept. of 1987. Since the mid-1970's, there has been a continuing decrease in the total column abundance of ozone over Antarctica during the late winter and early spring. This reduction now amounts to about one-half of the historical October mean. The results presented are derived from an ultraviolet ozone photometer. The ER-2 aircraft carrying 14 instruments participated in a major effort to penetrate the region of depletion. Data were gathered between altitudes of 53 deg and 72 deg S at pressure altitudes up to 21 km in a series of 12 flights. Additional data were obtained between latitudes of 37 deg N and 53 deg S on the 3 flight legs required to reach Punta Arenas from Moffett Field, CA, and on the same return legs to Moffett Field. The observed ozone mixing ratios indicate the effects of chemistry as well as the effects of the stratospheric polar vortex. Examples of the distributions of ozone mixing ratios as a function of altitude, latitude, or a time and the relationships to temperature and other trace gases are presented. Author

**N89-14553*#** National Oceanic and Atmospheric Administration, Boulder, CO. Aeronomy Lab.
**OBSERVATIONS OF DIURNAL VARIATIONS OF BrO AND OClO AT MCMURDO STATION, ANTARCTICA (78S) Abstract Only**
S. Solomon, R. W. Sanders (Colorado Univ., Boulder.), M. A. Carroll, and A. L. Schmeltekopf *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 139 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Observations of the diurnal variations of OClO and BrO during austral spring, 1987 using long-path visible and near-ultraviolet absorption spectroscopy are presented and compared to simplified model calculations. It is shown that care must be taken to compare model calculations and measurements along the line of sight of the instrument. Evening twilight observations of OClO are shown to be broadly consistent with current photochemical schemes,

assuming ClO and BrO levels near 50 mb of about 0.5 ppbv and 7 pptv, respectively, throughout the observing period from late Aug. to mid-Oct. Nighttime observations of OClO obtained using the moon as a light source display evidence for growth through the night in late-Aug., but not in late-Sept. Further, the observed morning twilight OClO abundances are in agreement with model calculations in late August, but generally fall below in late September and October. Observations of BrO in mid-Sept. systematically show far greater evening twilight than morning twilight abundances. Author

**N89-14554*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**IN SITU OBSERVATIONS OF ClO IN THE ANTARCTIC: EVIDENCE FOR CHLORINE CATALYZED DESTRUCTION OF OZONE**
J. G. Anderson, W. H. Brune, M. J. Proffitt (National Oceanic and Atmospheric Administration, Boulder, CO.), Walter L. Starr, and K. Roland Chan *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 143-146 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Results from a series of 12 ER-2 aircraft flights into the Antarctic polar vortex are summarized. These in situ data define the spatial and temporal distribution of ClO as the aircraft flew at an altitude of approx. 18 km from Punta Arenas (54 deg S latitude) to the base of the Palmer Peninsula (72 deg S latitude), executed a rapid descent to approx. 13 km, turned north and climbed bach to approximately 18 km, returning to Punta Arenas. A general pattern in the ClO distribution is reported: mixing ratios of approximately 10 ppt are found at altitude in the vicinity of 55 deg S increasing to 50 ppt at 60 degrees S. In the vicinity of 65 deg S latitude a steep gradient in the ClO mixing ratio is observed. At a fixed potential temperature, the ClO mixing ratio through this sharp transition increases by an order of magnitude within a very few degrees of latitude, thus defining the edge of the chemical containment vessel. From the edge of that containment vessel to the southern extension of the flights, 72 deg S, a dome of slowly increasing ClO best describes the distribution. Conclusion are drawn from the data. Author

**N89-14555*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**MEASUREMENTS OF NO AND TOTAL REACTIVE ODD-NITROGEN, NOy, IN THE ANTARCTIC STRATOSPHERE Abstract Only**
D. W. Fahey, D. M. Murphy, C. S. Eubank, G. V. Ferry, K. Roland Chan, and Malcolm K. W. Ko (Atmospheric and Environmental Research, Inc., Cambridge, MA.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 147-148 Prepared in cooperation with Colorado Univ., Boulder (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Measurements of NO and total reactive N, NOy, were made as part of the Airborne Antarctic Ozone Experiment conducted in Punta Arenas, Chile during Aug. and Sept. 1987. The total reactive N reservoir includes the species NO, NO2, NO3, N2 O5, HNO3, and ClONO2. The instrument was located on board the NASA ER2 aircraft which conducted 12 flights over the Antarctic continent reaching altitudes of 18 km at 72 deg S latitude. The NOy technique utilized the conversion of component NOy species to NO on a gold catalyst and the subsequent detection of NO by the chemiluminescence reaction of NO with ozone. Since the inlet sample line is heated and the catalyst operates at 300 C, NOy incorporated in aerosols evaporates and is converted to NO. NO was measured on two separate flights by removing the catalyst from the sample inlet line. Author

**N89-14556*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**MIXING RATIOS OF TRACE GASES IN THE AUSTRAL POLAR ATMOSPHERE DURING AUGUST AND SEPTEMBER OF 1987 Abstract Only**
James F. Vedder, Leroy E. Heidt, Walter H. Pollock, Bruce E. Henry, and Richard A. Lueb (National Center for Atmospheric Research, Boulder, CO.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 149 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Mixing ratios are presented for a number of long-lived trace gases in the austral polar atmosphere during August and September of 1987. The recent discovery of a 12-year trend of increasing depletion of ozone over the Antarctic Continent in the spring of each year led to numerous theoretical interpretations and several scientific expeditions to the region. The results herein were obtained as part of a major effort involving penetration of the region of ozone depletion by NASA's multi-instrumented aircraft. One of the 14 instruments on the high-altitude ER-2 aircraft collected pressurized air samples between latitudes of 53 degrees and 72 degrees south at pressure altitudes up to 21 km in a series of 12 flights from Punta Arenas, Chile, over the Palmer Peninsula. The sampling system, located in the nose section of ER-2, has an inlet tube in the free airstream, a metal-bellows air pump, and 14 specially treated 1.6 l stainless-steel canisters for containing the pressurized air at 350 kPa. A typical flight profile consisted of a southbound path on the 428 K potential temperature surface, a descent to a pressure altitude of 13.7 km, a climb to the 460 K surface, and return on this surface. Mixing ratios for the trace gases were obtained from gas chromatographic analyses of the pressurized air samples. Of the species measured, the mixing ratios for CH4, CO, N2O, CF2 Cl2, CFCl3, CH3, CCl3, CCl4, and C2F3Cl3 are reported here. Author

**N89-14557*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**SOUTHERN HEMISPHERIC NITROUS OXIDE MEASUREMENTS OBTAINED DURING 1987 AIRBORNE ANTARCTIC OZONE EXPERIMENT Abstract Only**
J. R. Podolske, M. Loewenstein, S. E. Strahan, and K. Roland Chan *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 150 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The chemical lifetime of N2O is about 150 years, which makes it an excellent dynamical tracer of air motion on the time scale of the ozone depletion event. For these reasons it was chosen to help test whether dynamical theories of ozone loss over Antarctica were plausible, particularly the theory that upwelling ozone-poor air from the troposphere was replacing ozone-rich stratospheric air. The N2O measurements were made with the Airborne Tunable Laser Absorption Spectrometer (ATLAS) aboard the NASA ER-2 aircraft. The detection technique involves measuring the diffential absorption of the IR laser radiation as it is rapidly scanned over an N2O absorption feature. For the AAOE mission, the instrument was capable of making measurements with a 1 ppb sensitivity, 1 second response time, over an altitude range of 10 to 20 kilometers. The AAOE mission consisted of a series of 12 flights from Punta Arenas (53S) into the polar vortex (approximately 72S) at which time a vertical profile from 65 to 45 km and back was performed. Comparison of the observed profiles inside the vortex with N2O profiles obtained by balloon flights during the austral summer showed that an overall subsidence had occurred during the winter of about 5 to 6 km. Also, over the course of the mission (mid-August to late September), no trend in the N2O vertical profile, either upward or downward, was discernible, eliminating the possibility that upwelling was the cause of the observed ozone decrease. Author

**N89-14558*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**OBSERVATIONAL RESULTS OF MICROWAVE TEMPERATURE PROFILE MEASUREMENTS FROM THE AIRBORNE ANTARCTIC OZONE EXPERIMENT**
Bruce L. Gary *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 151-153 (For

primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The Microwave Temperature Profiler, MTP, is installed on NASA's ER-2 aircraft. MTP measures profiles of air temperature versus altitude. Temperatures are obtained every 13.7 seconds for 15 altitudes in an altitude region that is approximately 5 km thick (at high flight levels). MTP is a passive microwave radiometer, operating at the frequencies 57.3 and 58.8 GHz. Thermal emission from oxygen molecules provides the signal that is converted to air temperature. MTP is unique in that it is the only airborne instrument of its kind. The MTP instrument was used during the Airborne Antarctic Ozone Experiment, AAOE, to enable potential vorticity to be measured along the flight track. Other uses for the MTP data have become apparent. The most intriguing unexpected use is the detection and characterization of mountain waves that were encountered during flights over the Palmer Peninsula. Mountain waves that propagate into the polar vortex may have implications for the formation of the ozone hole. Upward excursions of air parcels lead to a brief cooling. This can begin the process of cloud formation. It is important to determine how much additional formation of polar stratospheric cloud (PSC) material is possible by the passage of air parcels through a mountain wave pattern that endures for long periods. Other mountain wave effects have been suggested, such as a speeding up of the vortex, and a consequent cooling of large air volumes (which in turn might add to PSC production). Author

**N89-14559*#** Meteorological Office, Bracknell (England).
**PHOTOCHEMICAL TRAJECTORY MODELLING STUDIES OF THE 1987 ANTARCTIC SPRING VORTEX**
J. Austin, R. L. Jones, and D. S. McKenna *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 154-157 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Simulations of Antarctic ozone photochemistry performed using a photochemical model integrated along air parcel trajectories are described. This type of model has a major advantage at high latitudes of being able to simulate correctly the complex interaction between photolysis and temperature fields, which, because of the polar night cannot be represented accurately in a zonally averaged framework. Isentropic air parcel trajectories were computed using Meteorological Office global model analyses and forecast fields from positions along the ER-2 flight paths during the Airborne Antarctic Ozone Experiment in Austral Spring 1987. A photochemical model is integrated along these trajectories using the aircraft observations to initialize constituent concentrations. The model includes additional reactions of the ClO dimer and also bromine reactions, which are thought to play a significant role in Antarctica. The model also includes heterogeneous reactions which are invoked when the air parcel passes through a polar stratospheric cloud (PSC). The existence of a PSC is determined throughout the course of the model integration from the parcel temperature and the saturated vapour pressure of water over an assumed H2O/HNO3 mixture. The air parcel temperature is used to determine the saturated vapor pressure of HNO3 over the same mixture. Mixing ratios which exceed saturation result in condensation of the excess in the model and hence lead to a reduction of the amount of gas phase NO2 available for chemical reaction. Author

**N89-14560*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**TEMPERATURE AND HORIZONTAL WIND MEASUREMENTS ON THE ER-2 AIRCRAFT DURING THE 1987 AIRBORNE ANTARCTIC OZONE EXPERIMENT Abstract Only**
K. Roland Chan, Stan G. Scott, T. Paul Bui, Stuart W. Bowen, and Jon Day (Information Management International, Inc., Palo Alto, CA.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 158 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The NASA ER-2 aircraft is equipped with special instrumentation to provide accurate in situ measurement of the atmospheric state variables during flight. The Meteorological Measurement System (MMS) on the ER-2 aircraft is described. Since the meteorological parameters (temperature, pressure, and wind vector) are extensively used by other ER-2 experimenters for data processing and interpretation, the accuracy and resolution of each of these parameters are assessed and discussed. During the 1987 Airborne Antarctic Ozone Experiment (AAOE) mission, the ER-2 aircraft was stationed at Punta Arenas, Chile (53 S, 72 W), and successfully flew over Antarctica on 12 occasions between August 17 and September 22, 1987. On each of the 12 flights, the ER-2 aircraft flight plan was to take off at approximately the same local time, fly southward at a near constant potential temperature surface, descend and ascend at the southernmost terminus at about 72 S over Antarctica and return northward at either the same or a different constant potential temperature surface. The measurements of the MMS experiment during the AAOE mission are presented. MMS data are organized to provide a composite view of the polar atmosphere, which is characterized by frigid temperatures and high zonal winds. Altitudinal variations of the temperature measurement (during takeoff/landing at Punta Arenas and during descent/ascent at the southern terminus) and latitudinal variations of the zonal wind (on near constant potential temperature surfaces) are emphasized and discussed. Author

**N89-14561*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**TRACE GAS MEASUREMENTS FROM WHOLE AIR SAMPLES COLLECTED OVER THE ANTARCTIC CONTINENT Abstract Only**
L. E. Heidt, J. F. Vedder, Walter H. Pollock, Bruce E. Henry, and Richard A. Lueb (National Center for Atmospheric Research, Boulder, CO.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 159 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Whole air samples collected aboard the NASA DC-8 and ER-2 aircraft as part of the Airborne Antarctic Ozone Experiment (AAOE) were analyzed in a field laboratory set up at Punta Arenas, Chile, in August and September, 1987. Mixing ratios obtained from gas chromatographic analyses of these samples are presented for N2O, CFCl3, CFCl2, C2F3Cl3, CH3CCl3, CH4, and CO. Variations in the mixing ratios of these gases along the individual flight paths of the aircraft are used as tracers to indicate the history of air masses over and near the Antarctic continent. Author

**N89-14562*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**THE METEOROLOGICAL MEASUREMENT SYSTEM ON THE NASA ER-2 AIRCRAFT Abstract Only**
Stan G. Scott, T. Paul Bui, K. Roland Chan, and Stuart W. Bowen (San Jose State Univ., Calif.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 160 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

A Meteorological Measurement System (MMS) was designed for the high-altitude ER-2 aircraft (NASA 706). Through dedicated instrumentation installed on the aircraft and repeated calibrations, the MMS provides accurate in situ measurements of free-stream pressure, temperature, and the wind vector. The MMS has participated in two major high-altitude scientific expeditions, the Stratosphere-Troposphere Exchange Project (STEP) based in northern Australia and the Airborne Antarctic Ozone Experiment (AAOE) based in southern Chile. Key MMS subsystems are described. The MMS consists of a dedicated inertial navigation system (INS), a randome differential pressure system, a data acquisition system, and air data instrumentation. The MMS incorporates a high-resolution INS (Litton LIN-72RH model), which is specially configured and is updated at 25 Hz. The differential pressure system, consisting of two sets of pressure ports and transducers, is installed in the ER-2 radome to provide sensitive measurements of the airflow angles (angle of attack and angle of sideslip). The data acquisition system was designed to meet aircraft

requirements of compactness and light weight (2 cu ft 50 lb) and for MMS requirements to sample, control, process, and store 45 parameters (some redundant) at a sampling rate up to 10 Hz. The MMS data are stored both in a tape recorder (20 MB) and a hermatically-sealed winchester hard disc (10 MB). Special and redundant instrumentation for temperature and pressure measurements were also installed on the aircraft. Author

**N89-14563*#** National Oceanic and Atmospheric Administration, Boulder, CO. Aeronomy Lab.
**SYNOPTIC AND CHEMICAL EVOLUTION OF THE ANTARCTIC VORTEX IN WINTER AND SPRING, 1987 Abstract Only**
A. F. Tuck *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 165 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The dynamical evolution of the vortex at least up to 50 mb is dominated by synoptic scales in the troposphere. In particular, there is a clear response when poleward extension of tropospheric anticyclones from latitudes of 40 and 50 S to 70 and 80 S occurs. This response is evident in isentropic potential vorticity maps, TOMS ozone fields and SAM II polar stratospheric clouds. An important feature of the high latitude Southern Hemisphere lower stratosphere is a transition at potential temperatures in the 390 to 400 K range. This transition, the vortopause, is clearly marked in aircraft profiles of O3, H2O, N2O and ClO at latitudes 68 to 72 S near the Antarctic peninsula, and also cross-sections of potential vorticity and potential temperature; above it, the isopleths are more closely spaced than below it. The aircraft measurements of H2O, O3, NO sub y, N2O, ClO, and whole air data are examined in material coordinates, theta and P sub theta, backed up by trajectory analysis. The evolution of the chemical mixing ratios is examined in these coordinates as a function of time from mid-August to late September. Conclusions are drawn about the rates of change and their causes. The meteorological and aircraft data are examined for evidence of the following kinds of motion with respect to the vortex: ingress of air aloft, subsidence, peeling off of air to lower latitudes, and folding of the vortopause. Conclusions are presented regarding the evidence for a chemical sink of ozone above and below theta = 400 K, and whether the vortex has a mass flow through it, or if the chemical sink operates on a fixed mass of air. Implications for mid-latitudes are briefly considered in the light of the conclusions. Author

**N89-14564*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**DEHYDRATION IN THE LOWER ANTARCTIC STRATOSPHERE IN LATE WINTER AND SPRING Abstract Only**
K. K. Kelly, A. F. Tuck, D. W. Fahey, M. H. Proffitt, D. M. Murphy, R. L. Jones, D. S. McKenna, L. E. Heidt (National Center for Atmospheric Research, Boulder, CO.), G. V. Ferry, and M. Loewenstein et al. *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 166 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The history of minimum temperatures at 50 and 70 mb is examined from NMC, UK Met 0 and ECMWF analyses. MSU channel 24 data are similarly inspected. South Pole sonde data are used to calculate saturation humidity mixing ratio as a function of altitude and time throughout 1987. Saturation with respect to ice could be maintained for water mixing ratios of 3.5 ppmv for a period of about 80 days from mid-June to mid-September. Dehydration to mixing ratios of 1 ppmv or less was possible sporadically. Data from the ER-2 flights between 53 S and 72 S are used in conjunction with particle size measurements and air parcel trajectories to demonstrate the dehydration occurring over Antarctica. Water mixing ratios at the latitude of Punta Arenas (53 S), in conjunction with tracer measurements and trajectory analysis, show that at potential temperatures from about 325 to 400 K, the dryness (less than 3 ppmv) had its origin over Antarctica rather than in the tropics. Water mixing ratios within the Antarctic vortex varied from 1.5 to 3.8 ppmv, with a strong isentropic gradient being evident in the region of high potential vorticity gradients. Author

**N89-14565*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**TEMPORAL TRENDS AND TRANSPORT WITHIN AND AROUND THE ANTARCTIC POLAR VORTEX DURING THE FORMATION OF THE 1987 ANTARCTIC OZONE HOLE Abstract Only**
M. H. Proffitt, J. A. Powell, A. F. Tuck, D. W. Fahey, K. K. Kelly (National Oceanic and Atmospheric Administration, Boulder, CO.), M. Loewenstein, J. R. Podolske, and K. Roland Chan *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 167 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

During AAOE in 1987 an ER-2 high altitude aircraft made twelve flights out of Punta Arenas, Chile (53 S, 71 W) into the Antarctic polar vortex. The aircraft was fitted with fast response instruments for in situ measurements of many trace species including O3, ClO, BrO, NO sub y, NO, H2O, and N2O. Grab samples of long-lived tracers were also taken and a scanning microwave radiometer measured temperatures above and below the aircraft. Temperature, pressure, and wind measurements were also made on the flight tracks. Most of these flights were flown to 72 S, at a constant potential temperature, followed by a dip to a lower altitude and again assuming a sometimes different potential temperature for the return leg. The potential temperature chosen was 425 K (17 to 18 km) on 12 of the flight legs, and 5 of the flight legs were flown at 450 K (18 to 19 km). The remaining 7 legs of the 12 flights were not flown on constant potential temperature surfaces. Tracer data have been analyzed for temporal trends. Data from the ascents out of Punta Arenas, the constant potential temperature flight legs, and the dips within the vortex are used to compare tracer values inside and outside the vortex, both with respect to constant potential temperature and constant N2O. The time trend during the one-month period of August 23 through September 22, 1987, shows that ozone decreased by 50 percent or more at altitudes form 15 to 19 km. This trend is evident whether analyzed with respect to constant potential temperature or constant N2O. The trend analysis for ozone outside the vortex shows no downward trend during this period. The analysis for N2O at a constant potential temperature indicates no significant trend either inside or outside the vortex; however, a decrease in N2O with an increase in latitude is evident. Author

**N89-14566*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**SMALL SCALE STRUCTURE AND MIXING AT THE EDGE OF THE ANTARCTIC VORTEX Abstract Only**
D. M. Murphy, A. F. Tuck, K. K. Kelly (National Oceanic and Atmospheric Administration, Boulder, CO.), M. Loewenstein, J. R. Podolske, S. E. Strahan, and K. Roland Chan *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 168 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Small scale correlations and patterns in the chemical tracers measured from the NASA ER-2 aircraft in the 1987 AAOE campaign can be used to investigate the structure of the edge of the polar vortex and the chemically perturbed region within it. Examples of several types of transport processes can be found in the data. Since ClO and O3 have similar vertical gradients and opposite horizontal gradients near the chemically perturbed region, the correlation between ClO and O3 can be used to study the extent of horizontal transport at the edge of the chemically perturbed region. Horizontal transport dominates the correlation for a latitude band up to 4 degrees on each side of the boundary. This implies a transition zone containing a substantial fraction of the mass of the total polar vortex. Similar horizontal transport can be seen in other tracers as well. It has not been possible to distinguish reversible transport from irreversible mixing. One manifestation of the horizontal transport is that the edge of the chemically perturbed region is often layered rather than a vertical curtain. This can be

seen from the frequent reversed vertical gradients of NO2, caused by air with high NO2 overlapping layers with lower mixing ratios. Water and NO2 are positively correlated within the chemically perturbed region. This is the opposite sign to the correlation in the unperturbed stratosphere. The extent of the positive correlation is too great to be attributed solely to horizontal mixing. Instead, it is hypothesized that dehydration and descent are closely connected on a small scale, possibly due to radiative cooling of the clouds that also cause ice to fall to lower altitudes. Author

**N89-14567*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**TRANSPORT INTO THE SOUTH POLAR VORTEX IN EARLY SPRING Abstract Only**
D. Hartmann, L. E. Heidt (National Center for Atmospheric Research, Boulder, CO.), M. Loewenstein, J. Podolske, Walter L. Starr, and James F. Vedder *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 169 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Estimates of the mean circulation and diffusive transport of ozone and other species into the Antarctic polar vortex during the spring of 1987 are made using data from the Airborne Antarctic Ozone Experiment. Measurements of long-lived tracers of tropospheric origin remained relatively constant at the levels of the maximum rate of decline of ozone during September. At lower levels in the stratosphere some evidence exists to support intrusions of tropospheric or low latitude air. Given the distribution in latitude and height of these tracers measured from the ER-2 aircraft, it can be inferred that the Lagrangian or diabatic mean circulation was zero or downward over Antarctica during the period of the ozone decline. The observation of a decline in ozone therefore requires a photochemical sink for ozone. The magnitude of the required photochemical sink must be sufficient to offset the transport of ozone into the polar region and produce the observed decline. Quasi-isentropic mixing and downward motion are coupled and are difficult to estimate from a single tracer. The full suite of measured tracers and auxiliary information are brought together to provide an estimate of the rate at which air is cycled through the polar vortex during spring. Estimates of large scale transport of potential vorticity and ozone from previous years are generally consistent with the data from the airborne experiment in suggesting a relatively slow rate of mass flow through the polar vortex in the lower stratosphere during September. Author

**N89-14568*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**THE EVOLUTION OF AAOE OBSERVED CONSTITUENTS WITH THE POLAR VORTEX**
Mark R. Schoeberl, Leslie R. Lait, P. A. Newman, R. Martin, M. Loewenstein, J. R. Podolske, J. Anderson, and M. H. Proffitt (National Oceanic and Atmospheric Administration, Boulder, CO.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 170-172 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

One of the difficulties in determining constituent trends from the ER-2 flight data is the large amount of day to day variability generated by the motion of the polar vortex. To reduce this variability, the observations have been transformed into the conservative (Lagrangian) reference frames consisting of the coordinate pairs, potential temperature (PT) and potential vorticity (PV), or PT and N2O. The requirement of only two independent coordinates rests on the assumption that constituent distributions and their chemical processes are nearly zonal in that coordinate system. Flight data is used everywhere for these transformation except for potential vorticity. Potential vorticity is determined from level flight segments, and NMC PV values during flight dives and takeoffs are combined with flight data in a smooth fashion. Author

**N89-14569*#** Atmospheric and Environmental Research, Inc., Cambridge, MA.
**PHOTOCHEMICAL MODELING OF THE ANTARCTIC STRATOSPHERE: OBSERVATIONAL CONSTRAINTS FROM THE AIRBORNE ANTARCTIC OZONE EXPERIMENT AND IMPLICATIONS FOR OZONE BEHAVIOR**
Jose M. Rodriguez, Nien-Dak Sze, and Malcolm K. W. Ko *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 173-175 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The rapid decrease in O3 column densities observed during Antarctic spring has been attributed to several chemical mechanisms involving nitrogen, bromine, or chlorine species, to dynamical mechanisms, or to a combination of the above. Chlorine-related theories, in particular, predict greatly elevated concentrations of ClO and OClO and suppressed abundances of NO2 below 22 km. The heterogeneous reactions and phase transitions proposed by these theories could also impact the concentrations of HCl, ClNO3 and HNO3 in this region. Observations of the above species have been carried out from the ground by the National Ozone Expedition (NOZE-I, 1986, and NOZE-II, 1987), and from aircrafts by the Airborne Antarctic Ozone Experiment (AAOE) during the austral spring of 1987. Observations of aerosol concentrations, size distribution and backscattering ratio from AAOE, and of aerosol extinction coefficients from the SAM-II satellite can also be used to deduce the altitude and temporal behavior of surfaces which catalyze heterogeneous mechanisms. All these observations provide important constraints on the photochemical processes suggested for the spring Antarctic stratosphere. Results are presented for the concentrations and time development of key trace gases in the Antarctic stratosphere, utilizing the AER photochemical model. This model includes complete gas-phase photochemistry, as well as heterogeneous reactions. Heterogeneous chemistry is parameterized in terms of surface concentrations of aerosols, collision frequencies between gas molecules and aerosol surfaces, concentrations of HCl/H2O in the frozen particles, and probability of reaction per collision (gamma). Values of gamma are taken from the latest laboratory measurements. The heterogeneous chemistry and phase transitions are assumed to occur between 12 and 22 km. The behavior of trace species at higher altitudes is calculated by the AER 2-D model without heterogeneous chemistry. Calculations are performed for solar illumination conditions typical of 60, 70, and 80 S, from July 15 to October 31. Author

**N89-14570*#** Nagoya Univ. (Japan).
**DECENDING MOTION OF PARTICLE AND ITS EFFECT ON OZONE HOLE CHEMISTRY**
Y. Iwasaka *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 176-179 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Particle descending motion is one possible process which causes ozone loss near the tropopause in the Antarctic spring. However, this particle size distribution has not yet been measured. Particle settling is an important redistribution process of the chemical constituents contained in the particles. To understand particle settling effects on the Ozone Hole, information on the size distribution and the chemical composition of the particles is necessary. Author

**N89-14571*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**VARIATIONS OF TOTAL OZONE IN THE NORTH POLAR REGION AS SEEN BY TOMS Abstract Only**
Richard S. Stolarski and Arlin J. Krueger *In its* Polar Ozone Workshop. Abstracts May 1988 p 183 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Data from the TOMS instrument has been used to follow the course of development of the Antarctic ozone springtime minimum since 1979. Addressed is the question of possible north polar

region changes which might be deduced from the nine years of TOMS measurements of total ozone. Total ozone is a much more variable quantity in the Northern Hemisphere than in the Southern Hemisphere. This makes the search for trends more difficult and the interpretation of results more uncertain. The 9-yr time series of TOMS data at high latitudes in the Northern Hemisphere is examined. Because the TOMS measurements have drifted by 3 to 4 percent with respect to closely collocated Dobson measurements, it was chosen in this study to adopt the Dobson normalization and adjust the TOMS measurements accordingly. The difference between the last two years (1986 and 1987) of the TOMS record, and the first two years of the record (1979 and 1980) are shown. The difference in percent is given as a function of latitude and time of year. The Antarctic springtime decrease is clearly seen as well as a smaller change which extends to about 50 degrees south latitude at all seasons. Changes in the Northern Hemisphere are less dramatic and are concentrated near the polar night where solar zenith angles are very large. These data are now being examined in more detail and updated results will be presented at the Workshop. Author

**N89-14572*#** California Univ., Irvine.
**WINTERTIME LOSSES OF OZONE IN HIGH NORTHERN LATITUDES**
Neil Harris, F. S. Rowland, Rumen Bojkov, and Peter Bloomfield (North Carolina State Univ., Raleigh.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 184-185 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Total column ozone data over the past 22 to 30 years from ground-based Dobson and filter ozonometer stations between 30 N and 80 N are analyzed for residual trends remaining after allowance for the known geophysical variations corresponding to: (1) the change of seasons; (2) the quasi-biennial oscillation; and (3) the 11-year solar sunspot cycle. Examination of the data from several ground stations between 45 and 55 N indicated a seasonal difference in the long-term ozone series, with statistically significant losses in several winter months. Accordingly, the data from individual stations were analyzed with multiple regression analysis, seeking trends on a monthly basis after allowance for the known geophysical cycles. Previous statistical analyses were conducted as tests of 1-D model calculations which do not show any differences with the seasons, and any trend toward change in ozone concentrations is expressed in a yearly trend without seasonal variation. Such a model is inappropriate for calculations with a data set which exhibits a pronounced tendency toward seasonal differences in the trends. Comparisons with model calculations then require 2-D models into which seasonal and latitudinal differences can easily be programmed. Author

**N89-14573*#** Kernforschungsanlage, Juelich (Germany, F.R.).
**OBSERVATIONS OF STRATOSPHERIC SOURCE GAS PROFILES DURING THE ARCTIC WINTER Abstract Only**
U. Schmidt, R. Bauer, G. Kulessa, E. Klein, and B. Schubert *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 187 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

An international campaign was performed at ESRANGE rocket base, near Kiruna, Sweden (68 N) from January 4 to February 15 in order to investigate the Chemistry of Ozone in the Polar Stratosphere (CHEOPS). Within the framework of this campaign two sets of large stratospheric air samples were collected by means of a balloon borne cryogenic air sampler. The two balloons were launched on February 1, and February 10, 1988. At present the samples are analyzed in our laboratory for their contents of several long lived trace gases such as CH4, N2O, H2, CO2, CO and the major halocarbons CH3Cl, CFCl3, CF2Cl2, CCl4, CH3CCl3, and C2F3Cl3. The vertical profiles derived from these samples will be presented and compared with previous observations made in February 1987. The data will be discussed in view of the dynamical evolution of the Arctic polar vortex during this winter. Author

**N89-14574*#** Max-Planck-Inst. fuer Kernphysik, Heidelberg (Germany, F.R.).
**ROCKET- AND AIRCRAFT-BORNE TRACE GAS MEASUREMENTS IN THE WINTER POLAR STRATOSPHERE Abstract Only**
F. Arnold, O. Moehler, K. Pfeilsticker, and H. Ziereis *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 188 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

In January and February 1987 stratospheric rocket- and aircraft-borne trace gas measurements were done in the North Polar region using ACIMS (Active Chemical Ionization Mass Spectrometry) and PACIMS (PAssive Chemical Ionization Mass Spectrometry) instruments. The rocket was launched at ESRANGE (European Sounding Rocket Launching Range) (68 N, 21 E, Northern Sweden) and the twin-jet research aircraft operated by the DFVLR (Deutsche Forschungs- und Versuchs-anstalt fuer Luft- und Raumfahrt), and equipped with a mass spectrometer laboratory was stationed at Kiruna airport. Various stratospheric trace gases were measured including nitric acid, sulfuric acid, non-methane hydrocarbons (acetone, hydrogen cyanide, acetonitrile, methanol etc.), and ambient cluster ions. The experimental data is presented and possible implications for polar stratospheric ozone discussed. Author

**N89-14575*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**IN SITU OBSERVATIONS OF ClO IN THE WINTERTIME NORTHERN HEMISPHERE: ER-2 AIRCRAFT RESULTS FROM 21 N TO 61 N LATITUDE**
W. H. Brune, D. W. Toohey, J. G. Anderson (Harvard Univ., Cambridge, MA.), E. F. Danielsen, and Walter L. Starr *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 189-190 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Measurements of lower stratospheric ClO taken during a NASA ER-2 flight between Moffett Field, CA (37 N, 122 W) and Great Slave Lake, Canada (61 N, 116 W) on 13 February 1988 are reported. Northbound, the aircraft was flown at about 20 km altitude from 39 N to 56 N, at 18 km from there to 58 N, in a descent to 15 km at 60 N, and in a rise and turn at the northernmost point. The southbound leg was flown in a gradual climb from 20 km to 21.5 km. On this day, the central position of the Arctic polar vortex, as determined by an NMC analysis of heights and temperatures at the 50 mb and 70 mb levels, was approximately 79 N, 100 W. Because the vortex was located on the North American side of the pole, the aircraft was able to reach a point slightly inside the maximum horizontal wind region where wind speeds were 80 to 90 knots. The general pattern for the observed ClO is that it increased with both latitude and altitude, and attained a maximum of about 55 pptv at 61 N latitude and 20.5 km altitude. This value is about 20 times smaller than the maxima observed over Antarctica, but is comparable to those seen just outside the chemical containment vessel located inside the Antarctic Polar vortex. On the other hand, in a comparison with northern midlatitude data taken on this and three other February flights, ClO mixing ratios observed north of 55 N latitude are 2 to 5 times larger at all flight altitudes (15 to 20 km). Possible reasons are discussed for this enhancement over midlatitude and the evidence is considered for whether or not the instruments sampled Arctic polar vortex air. A second feature of the data is the strong positive correlation between ClO and O3 during the entire flight. Author

**N89-14576*#** National Oceanic and Atmospheric Administration, Boulder, CO. Aeronomy Lab.
**VISIBLE AND NEAR-ULTRAVIOLET SPECTROSCOPY AT THULE AFB (76.5 N) FROM JANUARY 28 - FEBRUARY 15, 1988 Abstract Only**
G. H. Mount, R. W. Sanders, R. O. Jakoubek (Colorado Univ., Boulder.), A. L. Schmeltekopf, and S. Solomon *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May

1988 p 191-192 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Near-ultraviolet and visible spectrographs identical to those employed at McMurdo Station, Antarctica (77.8 S) during the austral spring seasons of 1986 and 1987 were used to study the stratosphere above Thule, Greenland (76.5 N) during early spring, 1988. Observations were carried out both at night using the direct moon as a light source, and during the day by collecting the scattered light from the zenith sky when solar zenith angles were less than about 94.5 degrees. Excellent meteorological conditions prevailed in the troposphere and stratosphere at Thule. Surface weather was extremely clear over most of the period, facilitating measurements of the direct light from the moon. The lower stratospheric arctic polar vortex was located very near Thule throughout the observing period, and temperature at the 30 mbar level were typically below -80 C above Thule, according to the National Meteorological Center daily analyses. Thus conditions were favorable for polar stratospheric cloud formation above Thule. Total column ozone abundances were about 350 to 400 Dobson units, and did not suggest a clear temporal trend over the observing period. Stratospheric nitrogen dioxide measurements were complicated by the presence of a large component of tropospheric pollution on many occasions. Stratospheric nitrogen dioxide could be identified on most days using the absorption in the scattered light from the zenith sky, which greatly enhances the stratospheric airmass while suppressing the tropospheric contribution. These measurements suggest that the total vertical column abundance of nitrogen dioxide present over Thule in February was extremely low, sometimes as low as 3 x 10 to the 14th per sq cm. The abundance of nitrogen dioxide increased systemically from about 3 x 10 to the 14th in late January to 1.0 x 10 to the 15th per sq cm in mid-February, perhaps because of photolysis of N2O5 in the upper part of the stratosphere, near 25 to 35 km. Author

**N89-14577*#** Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France).
**OZONE AND NITROGEN DIOXIDE GROUND BASED MONITORING BY ZENITH SKY VISIBLE SPECTROMETRY IN ARCTIC AND ANTARCTIC**
J. P. Pommereau and F. Goutail *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 193-195 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Unattended diode array spectrometers have been designed for ground based stratospheric trace species monitoring by zenith sky visible spectrometry. Measurements are performed with a 1.0 nm resolution between 290 nm and 590 nm in order to allow simultaneous evaluations of column densities of ozone, nitrogen dioxide. Field tests have shown that the species can be monitored with a precision of + or - 2 Dobson for the first and + or - 2.10 to the 15th mol/sq cm for the second, although the absolute accuracy of the method is limited by the error of the estimation of the atmospheric optical path of the scattered light. Two identical instruments were set up in January 1988, one in Antarctica at Dumont d'Urville (66 S, 140 E) to be operated all year and another one in the Arctic at ESRANGE at Kiruna (68 N; 22 E) which will operate to the final warming of spring 1988. The data are processed in real time at both stations. O3 and NO2 columns are transmitted together with surface and stratospheric temperature and winds. They are also recorded for further treatment and search for OClO and BrO. Only one month of data from Antarctica is available at the moment. Obtained during polar summer, they cannot show more than stable columns of O3 and NO2 and for the last species, the buildup of its diurnal variation. Author

**N89-14578*#** Atmospheric Environment Service, Downsview (Ontario).
**CANOZE MEASUREMENTS OF THE ARCTIC OZONE HOLE**
W. F. J. Evans, J. B. Kerr, and H. Fast *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 196-198 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

In CANOZE 1 (Canadian Ozone Experiment), a series of 20 ozone profile measurements were made in April, 1986 from Alert at 82.5 N. CANOZE is the Canadian program for study of the Arctic winter ozone layer. In CANOZE 2, ozone profile measurements were made at Saskatoon, Edmonton, Churchill and Resolute during February and March, 1987 with ECC ozonesondes. Ground based measurements of column ozone, nitrogen dioxide and hydrochloric acid were conducted at Saskatoon. Two STRATOPROBE balloon flights were conducted on February 26 and March 19, 1987. Two aerosol flights were conducted by the University of Wyoming. The overall results of this study will be reported and compared with the NOZE findings. The results from CANOZE 3 in 1988, are also discussed. In 1988, as part of CANOZE 3, STRATOPROBE balloon flights were conducted from Saskatchewan on January 27 and February 13. A new lightweight infrared instrument was developed and test flown. A science flight was successfully conducted from Alert (82.5 N) on March 9, 1988 when the vortex was close to Alert; a good measurement of the profile of nitric acid was obtained. Overall, the Arctic spring ozone layer exhibits many of the features of the Antarctic ozone phenomenon, although there is obviously not a hole present every year. The Arctic ozone field in March, 1986 demonstrated many similarities to the Antarctic ozone hole. The TOMS imagery showed a crater structure in the ozone field similar to the Antarctic crater in October. Depleted layers of ozone were found in the profiles around 15 km, very similar to those reported from McMurdo. Enhanced levels of nitric acid were measured in air which had earlier been in the vortex. The TOMS imagery for March 1987 did not show an ozone crater, but will be examined for an ozone crater in February and March, 1988, the target date for the CANOZE 3 project. Author

**N89-14579*#** Atmospheric Environment Service, Downsview (Ontario).
**BREWER SPECTROPHOTOMETER MEASUREMENTS IN THE CANADIAN ARCTIC Abstract Only**
J. B. Kerr and W. F. J. Evans *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 199 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

In the winters of 1987 and 1988 measurements were conducted with the Brewer Spectrophotometer at Alert (82.5 N) and Resolute (74.5 N). The measurements were conducted as part of our Canadian Program to search for an Arctic Ozone Hole (CANOZE). Ozone measurements were conducted in the months of December, January and February using the moon as a light source. The total ozone measurements will be compared with ozonesonde profiles, from ECC sondes, flown once per week from Alert and Resolute. A modified Brewer Spectrophotometer was used in a special study to search for chlorine dioxide at Alert in March 1987. Ground based observations at Saskatoon in February and at Alert in March 1987 failed to detect any measureable chlorine dioxide. Interference from another absorbing gas, which we speculate may be nitrous acid, prevented the measurements at the low levels of chlorine dioxide detected in the Southern Hemisphere by Solomon et al. Author

**N89-14580*#** Oslo Univ. (Norway). Dept. of Physics.
**ZONE MEASUREMENTS DURING WINTERTIME IN THE ARCTIC. COMPARISION WITH RECENT MEASUREMENTS AT THE SAME PLACES ARE MADE. HERE THE 30 hPa TEMPERATURES ARE SHOWN Abstract Only**
Soren H. H. Larsen *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 200 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Moon measurements made at Tromso, and at Spitzbergen, 70 and 78 N, back in the fifties have been re-evaluated. One has to take into account that the wedge calibration will change when the focussed image of the moon on the inlet slit is used. A correction was later decided to be used after several experiments

in Dobsons Laboratory in Oxford. The absorption coefficients have been changed since the observations were taken and evaluated the first time. The re-evaluated ozone values have been plotted, in one diagram for Spitzbergen, and in one for Tromso. The zonal mean value for ozone is given as a reference. Ozone measurements from the winter season 1985/86 and 1986/87 made at the same places are presented. Here the daylight measurements are incorporated and also TIROS satellite data from single point data retrieval are given. The two winter seasons were very different. In the first we had a late final stratospheric warming, and in the other we had an early final stratospheric warming. This can be seen from the 30 millibar temperatures, provided by Barbara Naujokat, and plotted in the diagrams. Again the zonal mean values of ozone are given as reference. Author

**N89-14581*#** National Oceanic and Atmospheric Administration, Boulder, CO. Geophysical Monitoring for Climatic Change.

**SPRINGTIME SURFACE OZONE FLUCTUATIONS AT HIGH ARCTIC LATITUDES AND THEIR POSSIBLE RELATIONSHIP TO ATMOSPHERIC BROMINE**

Samuel J. Oltmans, Patrick J. Sheridan, Russell C. Schnell, and John W. Winchester (Florida State Univ., Tallahassee.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 201-203 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

At high Arctic stations such as Barrow, Alaska, springtime near-surface ozone amounts fluctuate between the highest and lowest values seen during the course of the year. Episodes when the surface ozone concentration is essentially zero last up to several days during this time of year. In the Arctic Gas and Aerosol Sampling Program (AGASP-I and AGASP-II) in 1983 and 1986, it was found that ozone concentrations often showed a very steep gradient in altitude with very low values near the surface. The cold temperatures, and snow-covered ground make it unlikely that the surface itself would rapidly destroy significant amounts of ozone. The AGASP aircraft measurements that found low ozone concentrations in the lowest layers of the troposphere also found that filterable excess bromine (the amount of bromine in excess of the sea salt component) in samples collected wholly or partially beneath the temperature inversion had higher bromine concentrations than other tropospheric samples. Of the four lowest ozone minimum concentrations, three of them were associated with the highest bromine enrichments. Surface measurements of excess filterable bromine at Barrow show a strong seasonal dependence with values rising dramatically early in March, then declining in May. The concentration of organic bromine gases such as bromoform rise sharply during the winter and then begin to decline after March with winter and early spring values at least three times greater than the summer minimum. Author

**N89-14582*#** Colorado Univ., Boulder.

**AIRBORNE MEASUREMENTS OF TROPOSPHERIC OZONE DESTRUCTION AND PARTICULATE BROMIDE FORMATION IN THE ARCTIC**

Russell C. Schnell, Patrick J. Sheridan, Richard E. Peterson, and S. J. Oltmans (National Oceanic and Atmospheric Administration, Boulder, CO.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 204-205 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Aircraft profiles of O3 concentrations over the Arctic ice pack in spring exhibit a depletion of O3 beneath the surface temperature inversion. One such profile from the NOAA WP-3D Arctic Gas and Aerosol Sampling Program (AGASP) flights in April, 1986 north of Alert, NWT (YLT, 82.5 N) is shown. The gradient of O3 across the temperature inversion, which is essentially a step function from tropospheric values (35 to 40 ppbv) to 0, is somewhat masked by a 1-min running mean applied to the data. Evidence is presented that O3 destruction beneath the Arctic temperature inversion is the result of a photochemical reaction between gaseous Br compounds and O3 to produce particulate Br aerosol. It is noted that in springtime, O3 at the Alert Baseline Station regularly decreases from 30 to 40 ppbv to near 0 over the period of a few hours to a day. At the same time, there is a production of particulate Br with a near 1.0 anti-correlation to O3 concentration. Surface concentrations of bromoform in the Arctic exhibit a rapid decrease following polar sunrise. AGASP aircraft measurements of filterable bromine particulates in the Arctic (March-April, 1983 and 1986) are shown. The greatest concentrations of Br aerosol (shown as enrichment factors relative to to Na in seawater, EFBR (Na)) were observed in samples collected beneath the surface temperature inversion over ice. Samples collected at the same altitude over open ocean (off Spitzbergen) labeled Marine did not exhibit similar Br enrichments. A second region of particulate Br enrichment was observed in the lower stratosphere, which regularly descends to below 500 mb (5.5 km) in the high Arctic. The NOAA WP-3D flew in the stratosphere on all AGASP flights and occasionally measured O3 concentrations in excess of 300 ppbv. Author

**N89-14583*#** Harvard Univ., Cambridge, MA. Dept. of Chemistry.

**IN SITU OBSERVATIONS OF BrO OVER ANTARCTICA: ER-2 AIRCRAFT RESULTS FROM 54 S TO 72 S LATITUDE**

W. H. Brune and J. G. Anderson *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 206-207 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Bromine monoxide was observed in situ at approximately 18 km altitude during nine flights of the NASA ER-2 aircraft from Punta Arenas, Chile (54 altitude) to 72 S latitude over the Palmer Peninsula, Antarctica. The first flight for the BrO detection system was on 28 August. Here, the results from the flights over Antarctica and from the ferry flights from Punta Arenas to Moffett Field, CA (37 N latitude are reported. A key question concerning BrO, then, is how it is distributed with respect to the chemical containment vessel defined by elevated ClO mixing ratios. This question is answered with greatest statistical significance if the data are averaged into five regions: outside the vessel, aircraft heading south; inside the vessel on the same potential temperature surface; in the dive region; inside the vessel on a given potential temperature surface, aircraft heading north; and outside the vessel on the same surface. The result is that the BrO distribution inside the chemical containment vessel was different from that found outside. Inside, the BrO mixing ratio was (5.0 plus or minus 1.1) pptv between the 400 K and 460 K potential temperature surfaces, decreasing only slightly with potential temperature, and was less than 3.6 pptv below the 4 00 K surface. The abundance of BrO inside the chemical containment vessel showed no discernible temporal trend during the course of the nine flights. Outside the vessel, the BrO mixing ratio was (4.7 plus or minus 1.3) pptv near the 450 K surface, but decreased to (2.8 plus or minus 1.0) pptv near the 420 K surface. Author

**N89-14584*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

**THE QBO AND INTERANNUAL VARIATION IN TOTAL OZONE**

Leslie R. Lait, Mark R. Schoeberl, Paul A. Newman (Applied Research Corp., Landover, MD.), and Richard S. Stolarski *In its* Polar Ozone Workshop. Abstracts May 1988 p 211-213 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Garcia and Soloman (1987) have noted that the October monthly mean minimum total ozone amounts south of 30 S were modulated by a quasibiennial oscillation (QBO) signal. The precise mechanism behind this effect, however, is unclear. Is the modulation brought about by the circulation-produced QBO signal in the ozone concentration itself, or does the temperature QBO modulate the formation of polar stratospheric clouds (PSCs), leading to changes in the chemically induced Antarctic spring ozone decline rate. Or is some other phenomenon involved. To investigate the means through which the QBO effect occurs, a series of correlation studies has been made between polar ozone and QBO signal in ozone and temperature. Author

**N89-14585*#** Atmospheric and Environmental Research, Inc., Cambridge, MA.

**ANTARCTIC OZONE DECREASE: POSSIBLE IMPACT ON THE SEASONAL AND LATITUDINAL DISTRIBUTION OF TOTAL OZONE AS SIMULATED BY A 2-D MODEL**

Malcolm K. W. Ko, Nien-Dak Sze, Debra K. Weisenstein, and Jose M. Rodriguez *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 214-215 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Satellite borne instruments, the Total Ozone Mapping Spectrometer (TOMS) and the Solar Backscatter Ultraviolet spectrometer (SBUV), show that total column ozone has decreased by more than 5 percent in the neighborhood of 60 S at all seasons since 1979. This is considerably larger than the decrease calculated by 2-D models which take into account solar flux variation and increases of trace gas concentrations over the same period. The meteorological conditions (warmer temperature and the apparent lack of polar stratospheric clouds) at these latitudes do not seem to favor heterogeneous chemistry as the direct cause for the observed ozone reduction. A mechanism involving the seasonal transport of ozone-poor air mass from within the polar vortex to lower latitudes (the so-called dilution effect) is proposed as a possible explanation for the observed year-round ozone reduction in regions away from the vortex. Author

**N89-14586*#** National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, NY.

**GLOBAL IMPACT OF THE ANTARCTIC OZONE HOLE: SIMULATIONS WITH A 3-D CHEMICAL TRANSPORT MODEL Abstract Only**

Michael J. Prather and Maria M. Garcia (Columbia Univ., New York, NY.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 216 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

A study of the Antarctic ozone hole was made with a 3-D chemical transport model using linearized photochemistry for ozone based on observed distribution. The tracer model uses the winds and convection from the GISS general circulation model (8 deg x 10 deg x 23 layers). A 3-year control run of the ozone distribution is compared with the observed climatology. In two experiments, a hypothetical Antarctic ozone hole is induced on October 1 and on November 1; the tracer model is integrated for 1 year with the standard linearized chemistry. The initial depletion, 90 percent of the O sub 3 poleward of 70 S between 25 and 180 mbar, amounts to about 5 percent of the total O sub 3 in the Southern Hemisphere. As the vortex breaks down and the hole is dispersed, significant depletions to column ozone, of order 10 D.U., occur as far north as 36 S during Austral summer. One year later, about 25 percent of the original depletion remains, mostly below 100 mbar and poleward of 30 S. Details of the calculations are shown, along with a budget analysis showing the fraction of the hole filled in by photochemistry versus that transported into the troposhere. Author

**N89-14587*#** Meteorological Office, Bracknell (England).

**DIAGNOSTIC STUDIES OF THE 1987 ANTARCTIC SPRING VORTEX**

J. Austin, R. L. Jones, and D. S. McKenna *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 217-220 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Dynamical fields form the UK Meteorological office global forecast model were used throughout the 1987 Airborne Antarctic Ozone Experiment (AAOE) for flight planning and diagnostic studies. Here, several studies based on the Meteorological Office global analysis (resolution 1.5 degrees lattitude x 1.875 degrees longitude, Lyne et al.) are described. The wind and temperature data derived from the model analysis are compared with observations made from both the DCB and ER-2, and an assessment of the model performance given. Derived quantities such as potential vorticity and model data and discrepancies due to the model data are discussed. Author

**N89-14588*#** Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.

**POLAR VORTEX DYNAMICS**

Michael McIntyre *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 221-223 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Recent work with high resolution, one-layer numerical models of fluid flows resembling those in the real stratosphere has suggested that: (1) the interiors of strong cyclonic vortices like the Antarctic polar vortex may be almost completely isolated laterally from their surroundings - perhaps even completely isolated, under some circumstances; (2) by contrast, material near the edge of such and isolated region can easily be eroded (or mixed one-sidedly) into the surrounding region; and (3) the erosion characteristically produces extremely steep gradients in isentropic distributions of potential vorticity (PV) and of other tracers, possibly down to horizontal length scales of a few kilometers only. Such length scales may occur both at the edge of the main polar vortex and in smaller features outside it, such as thin filamentary structures, produced by the erosion process. Author

**N89-14589*#** National Center for Atmospheric Research, Boulder, CO.

**EVOLUTION OF THE ANTARCTIC POLAR VORTEX IN SPRING: RESPONSE OF A GCM TO A PRESCRIBED ANTARCTIC OZONE HOLE**

B. A. Boville, J. T. Kiehl, and B. P. Briegleb *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 224-227 Sponsored in part by NSF (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

The possible effect of the Antartic ozone hole on the evolution of the polar vortex during late winter and spring using a general circulation model (GCM) is examined. The GCM is a version of the NCAR Community Climate Model whose domain extends from the surface to the mesosphere and is similar to that described on Boville and Randel (1986). Ozone is not a predicted variable in the model. A zonally averaged ozone distribution is specified as a function of latitude, pressure and month for the radiation parameterization. Rather that explicitly address reasons for the formation of the ozone hole, researchers postulate its existence and ask what effect it has on the subsequent evolution of the vortex. The evolution of the model when an ozone hole is imposed is then discussed. Author

**N89-14590*#** Clarkson Univ., Potsdam, NY. Dept. of Mathematics and Computer Science.

**THEORETICAL STUDY OF POLAR AND GLOBAL OZONE CHANGES USING A COUPLED RADIATIVE-DYNAMICAL 2-D MODEL Abstract Only**

H. Yang, K. K. Tung, and E. Olaguar *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 228 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

An existing 2-D model has recently been updated to incorporate ozone-temperature feedbacks with more comprehensive radiative transfer calculations and more detailed temperature data input. Researchers address the following issues: (1) given the observed temperature changes for the past eight years, quantitatively how much ozone change can be produced by the dynamical effect of the temperature change over the Arctic and Antarctic; (2) how much of the reported change in globally averaged ozone can be accounted for by temperature changes; (3) the role of the diabatic circulation changes in the lower stratosphere in determining the timing of the polar spring maximum and minimum; and (4) the role of the seasonal change in the diabatic circulation in causing the fall minimum over the Arctic and Antarctic. Author

**N89-14591*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**COMPARISON OF THE POLEWARD TRANSPORT OF OZONE IN THE NORTHERN AND SOUTHERN HEMISPHERES**
Marvin A. Geller, Mao-Fou Wu, and Eric R. Nash (Applied Research Corp., Landover, MD.) *In its* Polar Ozone Workshop. Abstracts May 1988 p 229-230 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Six and one-half years of ozone data and temperature data are used to extend Geller et al.'s (1988) study comparing the transport of ozone to high latitudes in the Northern and Southern Hemispheres. In this earlier study, it was pointed out that the poleward transport of ozone varies annually in the Northern Hemisphere but has a marked semiannual behavior in the Southern Hemisphere. This earlier study covered the period from December 1978 to November 1982. Two and one-half additional years have now been analyzed so that the analysis now extends to July 1986. With this extended data set, the maximum rate of increase in total ozone is seen to occur in January in the Northern Hemisphere for all of the years investigated. In the Southern Hemisphere, the maximum rate of increase is seen in September for almost all of the years with a secondary maximum in the rate of increase in total ozone often being seen during March-April period. The nature of the seasonal variation in total ozone is found to be much more variable in the Southern Hemisphere than in the Northern Hemisphere. Author

**N89-14592*#** Kyushu Univ., Fukuoka (Japan).
**RADIATIVE ASPECTS OF ANTARCTIC OZONE HOLE IN 1985**
H. Akiyoshi, M. Fujiwara, and M. Uryu *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 231-233 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

In order to investigate the radiative heating effects of aerosols during September - October, 1985, at Antarctica, researchers solved the radiative transfer equation using a one-dimensional model, which includes the absorption of solar energy by water vapor, carbon dioxide, ozone and aerosols, the thermal emission and absorption by the above species and in addition, Rayleigh and Mie scattering, and the surface scattering effects. In this calculation, they used data of ozone density, water vapor density and aerosol extinction at 0.385, 0.453, 0.525 and 1.02 mu m in the stratosphere obtained by SAGE II satellite and meteorological data from NOAA. Results show that the Antarctic stratosphere is nearly in radiative equilibrium during that period, if the effects of aerosols are excluded. It is also shown that the heating effects of aerosols are too small to cause effective upward motions, in spite of some ambiguous parameters such as aerosol composition. The parameter dependences of results are also discussed. Author

**N89-14593*#** Cambridge Univ. (England).
**ON THE ORIGIN OF STEEP EDGES AND FILAMENTS IN VORTICITY AND POTENTIAL VORTICITY FIELDS Abstract Only**
D. G. Dritschel *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 234 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

High-resolution numerical calculations are shown which capture the fundamental process responsible for the intensification of vorticity gradients in an isolated vortex subject to externally imposed distrubances. Imposition of almost any weak strain or shear field in stripping away the relatively weak vorticity at the edge of the vortex and leaves it with gradients four to six orders of magnitude greater than in the initial state. Calculations displaying such enormous gradients have never been reported previously, because of the artificial eddy diffusivities that always limit such gradients in standard numerical models. The present calculations, which have no such limitations, have been made possible by the development of a novel and robust new numerical technique for vortex dynamics called contour surgery. Author

**N89-14594*#** Cambridge Univ. (England).
**HIGH-RESOLUTION DYNAMICAL MODELLING OF THE ANTARCTIC STRATOSPHERIC VORTEX Abstract Only**
P. H. Haynes *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 235 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Progress is reported on the high-resolution three-dimensional numerical simulation of flows characteristic of the Antarctic wintertime stratosphere. The numerical model is a modified version of the Reading University sigma-coordinate used previously for tropospheric studies. Physical parameterizations are kept to a minimum in order to concentrate as much computing power as possible on simulating details of the dynamical processes. The major question addressed is whether the features observed in recent high-resolution two-dimensional simulations - namely: (1) the formation of a sharp edge to the vortex (seen in the potential vorticity field), (2) the survival of the polar vortex in a material entity, and (3) the formation of small-scale eddies rough the break-up of tongues of high potential vorticity drawn out from the polar vortex - are realized in three-dimensional simulations. Author

**N89-14595*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**SIMULATION OF THE TRANSPORT OF HALOGEN SPECIES FROM THE EQUATORIAL AND MID-LATITUDE STRATOSPHERE TO THE POLAR STRATOSPHERE IN A TWO-DIMENSIONAL MODEL**
Yuk L. Yung, R. L. Shia, M. Allen, R. W. Zurek, D. Crisp, and J. S. Wen *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 236-237 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The bulk of O sub 3 destruction in the Antarctic stratosphere takes place in the lower stratosphere between 15 and 25 km. Both O sub 3 and the halogen reservoir species have their origins in the higher altitude region (20 to 30 km) in the equatorial and mid-latitude stratosphere. Using the Caltech-JPL two-dimensional residual circulation model, researchers investigate the growth of stratospheric halogen due to the increase of CFCl sub 3 and CF sub 2 Cl sub 2. Author

**N89-14596*#** Science Research Council, Chilton (England).
**A TWO-DIMENSIONAL MODEL OF THE QUASI BIENNIAL OSCILLATION OF OZONE**
L. J. Gray and J. A. Pyle (Cambridge Univ., England ) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 240-243 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The largest amplitudes of the observed Quasi Biennial Oscillation (QBO) in column ozone are found in high latitudes and this must be taken into account in any explanation of the increased depletion of ozone in the southern polar spring during the 1980's. A QBO in zonal wind, temperature and column ozone has been successfully modelled in a two-dimensional dynamical/chemical model by the introduction of a parameterization scheme to model the transfer of momentum to the zonal flow associated with the damping of vertically propagating Kelvin and Rossby-Gravity waves. The largest anomalies in column ozone of approximately 20 DU are present at high latitudes. The equatorial ozone QBO is out of phase with the mid- and high-latitude ozone QBO, in good agreement with observations. Author

**N89-14597*#** Atmospheric and Environmental Research, Inc., Cambridge, MA.
**USE OF OPERATIONAL ANALYSES TO STUDY THE DYNAMICS OF TROPOSPHERE-STRATOSPHERE INTERACTIONS IN POLAR REGIONS**
David A. Salstein, Richard D. Rosen, and Alvin J. Miller (National Oceanic and Atmospheric Administration, Washington, DC.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop.

Abstracts May 1988 p 244-247 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Operational analyses produced by large weather centers have been used in the past to monitor various aspects of the general circulation as well as address dynamical questions. For a number years researchers have been monitoring National Meteorological Center (NMC) analyses at 100 millibars because it is the level from which stratospheric analyses are built. In particular, they closely examined the pressure-work term at that level which is an important parameter related to the forcing of the stratosphere by the troposphere. Rapid fluctuations typically seen in this quanity during the months of July-November, and similarly noted by Randel et al., (1987) may raise some concern about the quality of the analyses. Researchers investigated the behavior of the term mainly responsible for these variations, namely the eddy flux of heat, and furthermore have corroborated the presence of these variations in contemporaneous analyses produced by the European Centre for Medium Range Forecasts (ECMWF). Researchers demonstrated that fluctuations in standing eddy heat fluxes, related to the forcing of the stratosphere by the troposphere, agree in two largely independent meteorological analyses. Researchers believe, that these fluctuations are mostly real. Author

**N89-14598*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**CHEMISTRY OF CHLORINATED SPECIES IN THE ANTARCTIC STRATOSPHERE Abstract Only**
Mario J. Molina, Tai-Ly Tso, and Frank C.-Y. Wang *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 251-252 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The chemistry of Cl sub 2 O sub 2, the chlorine monoxide dimer, has been further investigated in order to better asses its potential role in catalytic ozone destruction cycles. The dimer has been generated in a flow system, in the 200 to 250 K temperature range, by using ozone and chlorine atoms as ClO precursors. The Cl-atoms are produced by a microwave discharge of either Cl sub 2, or of F sub 2 with subsequent addition of HCl. With this later scheme the dimer can be generated in the absence of Cl sub 2. The Fourier transform infrared spectra of the products clearly indicates the presence of two isomers, in agreement with earlier results (J. Phys. Shen., 91, 433, 1987). None of the observed IR bands can be attributed to a ClO-OClO adduct, since they all appear in the absence of any detectable amount of OCl. It is likely that the particles in the polar stratospheric clouds will have a relatively dilute nitric acid outer layer, even if the core is the nitric acid monohydrate, since the particles are in equilibrium with the ambient water vapor, which is present at levels of a few parts per million. Author

**N89-14599*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**STUDIES OF ClO AND BrO REACTIONS IMPORTANT IN THE POLAR STRATOSPHERE: KINETICS AND MECHANISM OF THE ClO+BrO AND ClO+ClO REACTIONS Abstract Only**
Randall R. Friedl and Stanley P. Sander *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 253-255 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The reactions, BrO + ClO yields Br + ClOO (1a) yields Br + OClO (1b) yields BrCl + O2 (1c) and ClO + ClO yields Cl + ClOO (2a) yields Cl + OClO (2b) yields Cl2 + O2 (2c) yields (ClO)2 (2d) have assumed new importance in explaining the unusual springtime depletion of ozone observed in the Antarctic stratosphere. The mechanisms of these reactions involve the formation of metastable intermediates which subsequently decompose through several energetically allowed products providing the motivation to study these reactions using both the discharge flow-mass spectrometric and flash photolysis - ultraviolet absorption techniques. These methods have also been used to explore aspects of the kinetics and spectroscopy of the ClO dimer. Author

**N89-14600*#** United Kingdom Atomic Energy Authority, Harwell (England). Engineering Sciences Div.
**STABILITY AND PHOTOCHEMISTRY OF ClO DIMERS FORMED AT LOW TEMPERATURE IN THE GAS PHASE**
R. A. Cox and G. D. Hayman *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 256-258 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

The recent observations of elevated concentrations of the ClO radical in the austral spring over Antarctica have implicated catalytic destruction by chlorine in the large depletions seen in the total ozone column. One of the chemical theories consistent with an elevated concentration of the ClO is a cycle involving the formation of the ClO dimer through the association reaction: ClO + ClO = Cl2O2 and the photolysis of the dimer to give the active Cl species necessary for O3 depletion. Here, researchers report experimental studies designed to characterize the dimer of ClO formed by the association reaction at low temperatures. ClO was produced by static photolysis of several different precursor systems: Cl sub 2 + O sub 3; Cl sub 2 O sub 2; OClO + Cl sub 2 O spectroscopy in the U.V. region, which allowed the time dependence of Cl sub 2, Cl sub 2 O, ClO, OClO, O sub 3 and other absorbing molecules to be determined. Author

**N89-14601*#** National Oceanic and Atmospheric Administration, Boulder, CO. Aeronomy Lab.
**MEASUREMENTS OF THE ClO RADICAL VIBRATIONAL BAND INTENSITY AND THE ClO + ClO + M REACTION PRODUCT**
James B. Burkholder, John J. Orlando, Philip D. Hammer, Carleton J. Howard, and Aaron Goldman (Denver Univ., CO.) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 259-262 Prepared in cooperation with Colorado Univ., Boulder (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

There is considerable interest in the kinetics and concentrations of free radicals in the stratosphere. Chlorine monoxide is a critically important radical because of its role in catalytic cycles for ozone depletion. Depletion occurs under a wide variety of conditions including the Antarctic spring when unusual mechanisms such as the BrO sub x/ClO sub x, ClO dimer (Cl sub 2 O sub 2), and ClO sub x/HO sub x cycles are suggested to operate. Infrared spectroscopy is one of the methods used to measure ClO in the stratosphere (Menzies 1979 and 1983; Mumma et al., 1983). To aid the quantification of such infrared measurements, researchers measured the ClO ground state fundamental band intensity. Author

**N89-14602*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**CHEMISTRY OF THE Co DIMER AT LOW TEMPERATURES**
W. B. DeMore and E. T. Roux (Calgary Univ., Alberta ) *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 263-265 (For primary document see N89-14503 06-45)
Avail: NTIS HC A14/MF A01 CSCL 13B

Researchers conducted a series of experiments on the chlorine-catalyzed photodecomposition of O sub 3 both in the gas and in inert solvents such as CF sub 4 and CO sub 2 in the temperature range about 190 to 225 K. The liquid medium was chosen in order to minimize possible surface loss of long-lived ClO dimer, and to aid in the stabilization of transient excited intermediates. The mechanism of dimer formation was as follows: (1) Cl sub 2 + hv yields Cl + Cl; (2) Cl + O sub 3 yields ClO + O sub 2; (3) ClO + ClO yields Cl sub 2 O sub 2. The experiments were done in cooled low temperature cells, with irradiation from an Osram high pressure mercury arc, filtered to remove radiation below 325 nm. Spectral analysis was by means of a Cary Model 2200 UV spectrometer. The principal objectives were: (1) to determine the lifetime of the dimer as a function of temperature;

(2) to observe spectral changes in the mixtures which could be attributed to dimer or related products; and (3) to observe chemical or photochemical reactions of the dimer. Author

**N89-14603*#** Cambridge Univ. (England). Dept. of Physical Chemistry.

**MODELLING THE ANTARCTIC LOWER STRATOSPHERE Abstract Only**

M. P. Chipperfield and J. A. Pyle *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 266 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Results form modeling studies of the Antarctic lower stratosphere which have attempted to simulate the large springtime ozone losses and corresponding changes in other trace constituents are given. These studies were carried out in a photochemical box model, a one-dimensional model without transport and in a two-dimensional photochemical-dynamical-radiation model. The photochemical studies have investigated inter alia the sensitivity of ozone to inclusion in the model of heterogeneous chemistry, and to the inclusion of the ClO dimer. When both of these are incorporated in the model, ozone depletions resembling those found in Halley Bay in 1987 (J.C. Farman, Nature, 329, 1987) can be reproduced. The temporal variations (both diurnal and during the August to October period) of a number of important tracers including HCl, ClONO2, OClO and BrO are discussed. The two-dimensional study concentrated on the difficulty of establishing in the model the dynamical preconditioning of the lower polar stratosphere - low temperatures, low N2O, etc., high ClOx. Calculations are presented to show: (1) the depletion of ozone during the springtime season, (2) the effect of large ozone losses on lower latitudes, and (3) the longer term (multi-year) variations of ozone in Antarctica, assuming realistic increases in the atmospheric halogen burden. Author

**N89-14604*#** Harvard Univ., Cambridge, MA.

**THE CHEMISTRY OF ANTARCTIC OZONE 1960-1987**

R. J. Salawitch, S. C. Wofsy, and M. B. McElroy *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 267-270 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

The factors that influence Antarctic ozone are examined with a view to understanding the observed historical trend. Researchers show that reduced ambient temperatures can dramatically enhance the efficiency of chemical removal processes. Attention is focused on positive feedback between levels of ozone, temperature, and rates of heterogeneous chemical reactions. ClO and its dimer, and high levels of these gases are maintained until the clouds evaporate, on 15 September for the simulation shown here. Author

**N89-14605*#** Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).

**MODELLING THE ANTARCTIC OZONE HOLE Abstract Only**

P. J. Crutzen and C. Bruhl *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 271 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Researchers performed model calculations of the ozone depletions taking place in the Antarctic lower stratosphere. Making the assumption that odd nitrogen is frozen out on stratospheric haze particles, an analysis is given of how much homogeneous reactions can contribute to ozone loss during September-October. Comparisons with observations indicate the potential importance of reactions with HCl in the polar stratospheric cloud particles. Author

**N89-14606*#** California Univ., Irvine. Dept. of Chemistry.

**STRATOSPHERIC FEEDBACK FROM CONTINUED INCREASES IN TROPOSPHERIC METHANE Abstract Only**

F. Sherwood Rowland and Donald R. Blake *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 272 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

Tropospheric concentrations of methane have increased steadily over the past ten years at an average rate of 16.5 ppbv per year, to a value in January 1988 of 1.69 ppmv. Measurements of CH sub 4 concentrations in air bubbles trapped in ice cores have shown concentrations of about 0.7 ppmv 200 years ago, with little further change for thousands of years before that. Interpolation earlier into this century suggests a concentration of about 1.1 to 1.2 ppmv in the 1940's. The only important pathway believed to be important for transfer of air from the troposphere to the stratosphere in through the tropical tropopause which is cold enough to reduce the mixing ratio of H sub 2 O in that air to about 3 ppmv. The only other major pathway for the delivery of H to the stratosphere is through the simultaneous injection of gaseous CH sub 4 in the same rising air. The formation of clouds in the stratosphere is dependent upon very low temperatures, and generally upon the amount of water vapor available. The possibility of a positive feedback exists, especially in well-oxidized methane air, that clouds are easier to form than earlier. This could mean enhancement of PSCs in both Antarctic and Arctic locations. Additional H sub 2 O in the stratosphere can also add to some of the greenhouse calculations. Author

**N89-14607*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**HIGH RESOLUTION FTIR SPECTROSCOPY OF THE ClO RADICAL**

Valerie Lang, Stanley P. Sander, and Randy Friedl *In* NASA, Goddard Space Flight Center, Polar Ozone Workshop. Abstracts May 1988 p 273-274 (For primary document see N89-14503 06-45)

Avail: NTIS HC A14/MF A01 CSCL 13B

The chlorine monoxide radical, ClO, plays a significant role in the catalytic destruction of ozone in the Earth's stratosphere. Because of its atmospheric importance, ClO has been the subject of numerous observational attempts. In order to deduce ClO concentrations from stratospheric infrared measurements, the infrared spectroscopy of ClO must be well characterized. Approximately 830 individual lines were measured form ClO imfrared spectra with the ClO concentration between 1 x 10 to the 13th power and 6 x 10 to the 13th power molecules per cu cu. The lines were then averaged and fit to a function of m (where m = O, -J or J+1 for the Q,P and R branches respectively) to obtain the band strength, S sub v and the first Herman-Wallis coefficient, alpha. The total S sub v for the two main isotopmers was 13.11 plus or minus 1 cm(-2) atm(-1) while alpha was 0.00412 plus or minus .00062. Author

**N89-14608#** Environmental Protection Agency, Corvallis, OR. Environmental Research Lab.

**ANALYSIS OF CROP LOSS FOR ALTERNATIVE OZONE EXPOSURE INDICES**

David T. Tingey, William E. Hogsett, and E. Henry Lee (Northrop Services, Inc., Corvallis, Oreg.) May 1988 15 p (PB88-214788; EPA-600/D-88-118) Avail: NTIS HC A03/MF A01 CSCL 13B

Defining the appropriate exposure index that best relates plant response to exposure necessitates a consideration of the underlying biological basis for the response and a method for characterizing the temporal variations in pollutant occurrence. Although no single index was deemed best (in all cases) for relating O3 exposure to plant response, the top-performing exposure indices were those that: (1) cumulate the hourly O3 concentrations over time, (2) emphasize concentrations of 0.06 ppm and higher either by continuous sigmoid weights or by discrete (0 or 1) weights of the threshold indices. The best index gave greater weight to exposures occurring 20 to 40 days before harvest. When assessing the impact of O3 on plant growth, these findings illustrate the importance of exposure duration, the importance of repeated peaks, and the time of increased plant sensitivity. GRA

**N89-14609#** Systems Applications, Inc., San Rafael, Calif.
**USER'S GUIDE FOR EXECUTING OZIPM-4 (OZONE ISOPLETH PLOTTING WITH OPTIONAL MECHANISMS, VERSION 4) WITH CBM-4 (CARBON-BOND MECHANISM-4) Final Report, Jul. 1985 - Jun. 1987**
H. Hogo and M. W. Gery May 1988 175 p
(Contract EPA-68-02-4136)
(PB88-221965; EPA-600/8-88-073B; EPA/SW/MT-88/053B)
Avail: NTIS HC A08/MF A01 CSCL 13B

An updated version of the Ozone Isopleth Plotting Program has been developed for use with EKMA to calculate emission reductions needed to achieve the air quality standard for ozone. The program, called OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms - Version 4), contains the new Carbon-Bond Mechanism-4 (CBM-4). In addition to containing a new mechanism, the OZIPM-4 expands on earlier versions of the code by providing a wider compatibility between computers, an improved isopleth plotting package, expanded user interaction with control strategy calculations, and a new option for determining credits for reductions in CO emissions. Volume 1 of the report serves as the User's Manual for OZIPM-4. Volume 2 contains the listing of the FORTRAN computer code. GRA

**N89-14610#** Environmental Protection Agency, Washington, DC. Office of Air and Radiation.
**ASSESSING THE RISKS OF TRACE GASES THAT CAN MODIFY THE STRATOSPHERE. VOLUME 1: EXECUTIVE SUMMARY**
John S. Hoffman, ed. Dec. 1987 101 p
(PB88-231055; EPA-400/1-87-001A-Vol-1) Avail: NTIS HC A06/MF A01; also available in set of 8 reports HC E99 as PB88-231048 CSCL 13B

This is one of a series of 8 documents that examines the human health, environmental and atmospheric risks associated with a decrease in stratospheric ozone. It provides a synopsis of current understanding of how atmospheric composition may change and the effects the change is likely to have on ozone abundance and its vertical distribution. It includes the impacts of the changes in ozone on human health, polymers, plants and aquatic systems. It also examines related changes in climate and the potential impacts of climate change on sea level rise, agriculture, human health, water resources and forests. Author

**N89-14611#** Environmental Protection Agency, Washington, DC. Office of Air and Radiation.
**ASSESSING THE RISKS OF TRACE GASES THAT CAN MODIFY THE STRATOSPHERE. VOLUME 6: TECHNICAL SUPPORT DOCUMENTATION PRODUCTION PROJECTIONS**
John S. Hoffman, ed. Dec. 1987 349 p
(PB88-231071; EPA-400/1-87-001F-Vol-6) Avail: NTIS HC A15/MF A01; also available in set of 8 reports HC E99 as PB88-231048 CSCL 13B

This is one of a series of 8 documents that examines the human health, environmental and atmospheric risks associated with a decrease in stratospheric ozone. This volume discusses: probabilistic projections of chlorofluorocarbon consumption; scenarios of chlorofluorocarbon use; from 1985 to 2075; product uses and market trends for potential ozone depleting substance from 1985 to 2000; and an analytic method for constructing scenarios from a subjective joint possibility distribution. Author

**N89-14612#** Environmental Protection Agency, Washington, DC. Office of Air and Radiation.
**ASSESSING THE RISKS OF TRACE GASES THAT CAN MODIFY THE STRATOSPHERE. VOLUME 7: TECHNICAL SUPPORT DOCUMENTATION ATMOSPHERIC SCIENCE PAPERS**
John S. Hoffman, ed. Dec. 1987 214 p
(PB88-231089; EPA-400/1-87-001G-Vol-7) Avail: NTIS HC A10/MF A01; also available in set of 8 reports HC E99 as PB88-231048 CSCL 13B

This is one of a series of documents which examines the human health, environmental and atmospheric risks associated with a decrease in stratospheric ozone. Included are 5 atmospheric science papers on atmospheric modeling. Photochemistry model sensitivity to chlorine perturbations, ozone perturbations in the LLNL one dimensional model, Monte Carlo uncertainty analysis of stratospheric ozone, ozone changes of the troposphere and stratosphere, and ultraviolet solar flux incident on the biosphere are discussed. Author

**N89-14613#** Environmental Protection Agency, Washington, DC. Office of Air and Radiation.
**ASSESSING THE RISKS OF TRACE GASES THAT CAN MODIFY THE STRATOSPHERE. VOLUME 8: TECHNICAL SUPPORT DOCUMENTATION OZONE DEPLETION AND PLANTS**
Alan H. Teramura (Maryland Univ., College Park.) Dec. 1987 138 p
(PB88-231097; EPA-400/1-87-001H-Vol-8) Avail: NTIS HC A07/MF A01; also available in set of 8 reports HC E99 as PB88-231048 CSCL 13B

This is one of a series of 8 documents that examines the human health, environmental and atmospheric risks associated with a decrease in stratospheric ozone. It focuses on issues and uncertainties in assessing the effects of UV-B radiation on plants as well as risks to crop yield resulting from an increase in solar UV-B radiation. Recommendations are made for improving field experimental design and management. Author

**N89-14614#** Environmental Research Lab., Duluth, MN.
**SIMPLIFYING COMPLEX QSAR's (QUANTITATIVE STRUCTURE-ACTIVITY RELATIONSHIPS) IN TOXICITY STUDIES WITH MULTIVARIATE STATISTICS**
Gerald J. Niemi and James M. McKim Jul. 1988 13 p
(PB88-233937; EPA-600/D-88-142) Avail: NTIS HC A03/MF A01 CSCL 13B

During the past several decades many quantitative structure-activity relationships (QSAR's) have been derived from relatively small data sets of chemicals in a homologous series and selected empirical observations. An alternative approach is to analyze large data sets consisting of heterogeneous groups of chemicals and to explore QSAR's among these chemicals for generalized patterns of chemical behavior. The use of exploratory multivariate statistical techniques for simplifying complex QSAR problems is demonstrated through the use of research data on biodegradable and mode of toxic action. In these examples, a large number of explanatory variables were examined to explore which variables might best explain whether a chemical biodegrades or whether a toxic response by an organism can be used to identify a mode of toxic action. In both cases, the procedures reduced the number of potential explanatory variables and generated hypotheses about biodegradation and mode of toxic action for future research without explicitly testing an existing hypothesis. Author

**N89-14615#** Manhattan Coll., New York. Dept. of Environmental Engineering and Science.
**STATISTICAL MODEL OF ENVIRONMENTAL CONTAMINANTS USING VARIANCE SPECTRUM ANALYSIS**
R. V. Thomann Aug. 1987 195 p
(Grant NSF CEE-84-10547)
(PB88-235130; NSF/ENG-87053) Avail: NTIS HC A09/MF A01 CSCL 13B

The purpose of the project is to develop techniques for predicting statistical properties of the concentrations of potentially toxic chemicals in aquatic organisms, such as fish. The statistical properties include mean, variance, coefficient of variation, autocorrelation, and variance spectrum functions. The research direction is prompted by the need to relate the variability of the effluent concentration of chemicals to the variability in the water column and then, in turn, to the variability in a target aquatic organism. GRA

**N89-14616#** Federal Aviation Administration, Washington, DC. Office of Environment and Energy.
**A MICROCOMPUTER POLLUTION MODEL FOR CIVILIAN AIRPORTS AND AIR FORCE BASES, MODEL DESCRIPTION**
H. M. Segal and P. L. Hamilton (Minority Services, Inc., Washington, DC.) Aug. 1988 140 p
(AD-A199003; FAA-EE-88-4; AFESC/ESL-TR-88-53) Avail: NTIS HC A07/MF A01 CSCL 24A

This is one of three reports describing the Emissions and Dispersion Modeling System (EDMS). EDMS is a complex source emissions/dispersion model for use at civilian airports and Air Force bases. It operates in both a refined and a screening mode and is programmed for an IBM-XT (or compatible) computer. This report--MODEL DESCRIPTION--provides the technical description of the model. It first identifies the key design features of both the emissions (EMISSMOD) and dispersion (GIMM) portions of EDMS. It then describes the type of meteorological information the dispersion model can accept and identifies the manner in which it preprocesses National Climatic Center (NCC) data prior to a refined model run. The report presents the results of running EDMS on a number of different microcomputers and compares EDMS results with those of comparable models. The appendices elaborate on the information noted above and list the source code. GRA

**N89-14617#** Battelle Columbus Labs., OH.
**AIRCRAFT EMISSIONS CHARACTERIZATION Final Report, Sep. 1986 - Aug. 1987**
C. W. Spicer, M. W. Holdren, S. E. Miller, D. L. Smith, R. N. Smith, and D. P. Hughes Mar. 1988 74 p
(Contract F08635-85-C-0122)
(AD-A197864; AFESC/ESL-TR-87-63) Avail: NTIS HC A04/MF A01 CSCL 24A

Assessment of the environmental impact of aircraft operations is required by Air Force regulations. This program was undertaken to quantify gaseous and particulate emissions associated with three Air Force turbine engines (TF33-P3, TF33-P7, and J79- smokeless). The emissions tests were carried out, using a test cell at Tinker AFB, Oklahoma City, OK. All tests employed JP-4 as the fuel, and fuel samples were characterized by standard tests and analyzed for composition. Emissions were measured at power settings of idle, 30 percent, 75 percent, and 100 percent. Measurements were made of detailed organic composition, CO, CO2, NO, NOx, smoke number, particle concentration, and particle size distribution. A multiport sampling rake was used to sample the exhaust, and heated Teflon tubing was used to transfer exhaust to the monitoring instrumentation. Measured and calculated fuel/air ratios were compared to assure representative sampling of the exhaust. The results have been used to calculate emission indices and emission rates for CO, CO2, total hydrocarbons, NO, NO2, and NOx. The distribution of organic compounds in the exhaust from the different engines and at various power settings has been compared, and the distribution by compound class and by carbon number are reported. Smoke numbers and particle size distributions have been derived from the test data. The report also contains a review of the emissions of selected toxic chemicals, and a comparison with other emission sources. GRA

**N89-14904*#** Morgan State Univ., Baltimore, MD. Dept. of Comprehensive Science and Science Education.
**THE EFFECTS OF BIOMASS BURNING ON THE CONCENTRATION OF TRACE GASES IN THE ATMOSPHERE Abstract Only**
Leon M. Donaldson *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 53-54 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 13B

# 46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

**N89-14618** Wisconsin Univ., Madison.
**DYNAMICAL ADJUSTMENTS IN THE PLANETARY BOUNDARY LAYER Ph.D. Thesis**
Jong-Ghap Jhun 1987 175 p
Avail: Univ. Microfilms Order No. DA8727236

The understanding and applications in involving flow in the planetary boundary layer (PBL) require better knowledge of mutual large scale adjustment processes between wind, mass and turbulence fields, called PBL adjustment. These processes for frictionally decaying circulations over the ocean were analyzed for idealized one and two layer PBL models on both the midlatitude f- and equatorial beta-planes. Three mechanisms are found to have varying impacts on the flows: direct decay, energy dispersion, and spin-down mass adjustment. For large horizontal scales in a one layer model, friction causes inertial gravity waves to decay rapidly and geostrophic waves slowly on the f-plane, while all types of waves decay fast on the equatorial beta-plane. For a two layer model subcloud-layer friction causes barotropic waves to decay slowly and baroclinic waves rapidly both on the f- and equatorial beta-planes. The lower layer friction effect in the two layer system on the f-plane is to create divergent winds for barotropic geostrophic waves in both layers and to create secondary circulations and spin-down processes. Results from the initial value problem approach in the midlatitudes are given and briefly discussed. Dissert. Abstr.

**N89-14619#** National Oceanic and Atmospheric Administration, Boulder, CO. Space Environment Lab.
**TIROS/NOAA (TELEVISION AND INFRARED OBSERVATION SATELLITE/NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION) SATELLITES SPACE ENVIRONMENT MONITOR ARCHIVE TAPE DOCUMENTATION, 1988 UPDATE**
V. J. Hill, D. S. Evans, and H. H. Sauer May 1988 54 p
(PB88-224613; NOAA-TM-ERL-SEL-77) Avail: NTIS HC A04/MF A01 CSCL 04A

TIROS/NOAA satellite archive tapes containing data obtained with the Medium Energy Proton and Electron Detector (MEPED), High Energy Proton and Alpha Particle Detector (HEPAD), and Total Energy Detector (TED) are described. Descriptions of the data include orbital and housekeeping details and the information needed to decode and understand the data. Specifications of the data channels are supplied, with the timing information needed to convert the data to usable information. Description of the archive tape format gives the information needed to read the tape and unpack the data. Appendices supply the retrieval routines used by the Space Environment Services Center in Boulder. Author

**N89-14620** Wisconsin Univ., Madison.
**LARGE SCALE FEATURES OF THE ATMOSPHERIC WATER VAPOR TRANSPORT OVER THE AMAZON REGION Ph.D. Thesis**
Nelson Jesus Ferreira 1987 154 p
Avail: Univ. Microfilms Order No. DA8800354

The large scale features of the atmospheric water vapor (WV) transport over the Amazon Basin (AB) during the First Global GARP Experiment (FGGE) in 1979, and the Global Tropospheric Experiment/Atmospheric Boundary Layer Experiment (GTE/ABLE) in July 1985 are examined. Analyses of the atmospheric WV content over South America (SA) for the FGGE year shows that during the southern summer high precipitable water (PW) areas are associated with the Intertropical Convergence Zone (ITCZ), the upper level Bolivian anticyclonic circulation and the SA Convergence Zone (SACZ). Reflecting the seasonal displacement of the convective activity and the fluctuations in the trade wind system, the zone with high PW shrinks and is restricted to lower latitudes of SA during the southern winter. Bimonthly mean vertically integrated WV transport indicates that a zone of westward transport

prevails at low latitudes of SA while eastward transport dominates the subtropics. The transition zone of these transport regimes, the SACZ, is characterized by a southward transport of moisture. Results of the atmospheric WV balance during the FGGE reveals that the hydrological cycle of the AB operates in two modes: wet and dry. Dissert. Abstr.

**N89-14621*#** Michigan Univ., Ann Arbor. Radiation Lab.
**DETERMINATION OF SOIL MOISTURE BENEATH A STALK OR TRUNK DOMINATED CANOPY**
K. C. McDonald, M. C. Dobson, and F. T. Ulaby 1988 22 p
(Grant NAG5-480)
(NASA-CR-183322; NAS 1.26:183322) Avail: NTIS HC A03/MF A01 CSCL 08M

An overview of a radiative transfer model; a model computation example; and the application of the model to determine soil moisture are presented. B.G.

**N89-14622#** National Center for Atmospheric Research, Boulder, CO.
**RETRIEVAL OF ATMOSPHERIC TEMPERATURES AND GAS VOLUME MIXING RATIOS AND COLUMN AMOUNTS FROM INFRARED SOLAR ABSORPTION SPECTRA Ph.D. Thesis - Ohio State Univ.**
Bo Cai Gao 1988 366 p
(Grant NSF ATM-87-09659)
(PB88-236153; NCAR-CT-113) Avail: NTIS HC A16/MF A01 CSCL 04A

Atmospheric temperatures and ray tangent heights between 20 and 70 km were retrieved with precisions of 2 to 5 k and 0.2 and 0.6 km from analysis of equivalent widths of temperature sensitive and temperature insensitive CO2 lines in infrared solar occulation spectra obtained from a satellite experiment (ATMOS). Volume mixing ratio profiles of H2O, CH4, N2O, CO and NO above 20 km were obtained. Within the population precision of about 20 percent, no departures from local thermodynamic equilibrium distributions for an excited vibrational state of CO2 between 60 and 100 km were found. Infrared solar absorption spectra between 2 and 16 micrometers were collected from the ground for one year with a Fourier transform interferometer with a resolution of 0.06/cm. H2O, CO2, O3, N2O, CO, CH4, HNO3, HF, HCl, OCS, H2CO. N2, HCN, C2H2, C2H6, CFCl3, CF2Cl2, CHF2Cl and ClONO2 absorption features were observed. The derived column amount precisions for most gases are 5 to 15 percent. Author

**N89-14623#** Kiruna Geophysical Inst. (Sweden).
**KIRUNA GEOPHYSICAL DATA: DATA SUMMARY OCT. - DEC. 1987**
Bo Thelin, ed. 1987 56 p
(PB88-236633) Avail: NTIS HC A04/MF A01 CSCL 08G

The Kiruna Geophysical Data is a collection of results of ground-based more or less continuous measurements of upper atmosphere variables carried out at the Swedish Institute of Space Physics. The objective is to present current geophysical data, relative to polar upper atmospheric conditions, to those who require it for their research. GRA

**N89-14624*#** California Inst. of Tech., Pasadena.
**DETERMINATION OF CONVERGENCE RATES ACROSS THE VENTURA BASIN, SOUTHERN CALIFORNIA, USING GPS AND HISTORICAL TRIANGULATION**
Andrea Donnellan, Bradford H. Hager, and Shawn Larsen [1988] 14 p
(Grant NAG5-842)
(NASA-CR-183014; NAS 1.26:183014) Avail: NTIS HC A03/MF A01 CSCL 08G

Comparison of angles from historical triangulation observations dating as far back as 1932 with Global Positions System (GPS) measurements taken in 1987 indicates that rapid convergence may be taking place on decade timescales in the central and eastern part of the Ventura basin, an east-west trending trough bounded by thrust faults. Changes in angles over this time were analyzed using Prescott's modified Frank's method and in terms of a model which assumes that the regions to the north and south of the basin are rigid blocks undergoing relative motion. For the two block model, inversion of the observed angle changes over the last 28 years for the relative motion vector leads to north-south convergence across the basin of 30 + or - 5 mm/yr, with a left lateral component of 10 + or - 1 mm/yr in the Fillmore-Santa Paula area in the central part of the basin. The modified Frank's method yields strain rates of approximately 2 microrad/yr in both the east and central parts of the basin for measurements spanning the 1971 San Fernando earthquake. Assuming no east-west strain yeilds north-south compression of approximately 3.5 + or - .2 cm/yr. Comparison of triangulation data prior to the earthquake shows no strain outside the margin of error. The convergence rates determined by geodetic techniques are consistent with geologic observations in the area. Such large geodetic deformation rates, with no apparent near-surface creep on the major thrust, can be understood if these faults become subhorizontal at relatively shallow depths and if the subhorizontal portions of the faults are creeping. An alternative explanation of the large displacement rates might be that the pumping of oil in the vicinity of the benchmarks caused large horizontal motions, although it is unlikely that meter scale horizontal motions are due to oil withdrawal. These and other hypotheses are evaluated to better constrain the tectonics of this active region. Author

**N89-14625#** Johann-Wolfgang-Goethe-Univ., Frankfurt am Main (Germany, F.R.). Inst. fuer Meteorologie und Geophysik.
**SCIENTIFIC EVALUATION AND ASSESSMENT OF ASL DEVELOPED MOIST ATMOSPHERE MODELS FOR LOW STRATUS SUBCLOUDS**
Gottfried Haenel, Henry Rachele, and Neal Kilmer 1987 3 p
(Contract DAJA45-87-M-0333)
(AD-A198762; R/D-5870-AN-01) Avail: NTIS HC A02/MF A01 CSCL 04A

The problem is to describe the thermodynamics and haze microphysics of the subcloud layer. This is extremely difficult if the cloud is low and the lower boundary of the subcloud layer is the ground like in the present case. In such a case an adequate description of the turbulent processes in the subcloud layer is necessary to get reliable results. The related problems are difficult because the condensation processes have a considerable influence on turbulence. Comparison of measured and computed liquid water profiles in the subcloud layer fields indicates that there should be an agreement between present theory and reality within a factor of about 3. Considering the errors of measurement and the above mentioned suggestions, this agreement is judged to be very good and promising. Further steps of improvements of the model and its final version should be checked by well-designed experiments. GRA

**N89-14626#** Pennsylvania State Univ., University Park. Dept. of Meteorology.
**LONG TERM STUDIES OF THE REFRACTIVE INDEX STRUCTURE PARAMETER IN THE TROPOSPHERE AND STRATOSPHERE Final Report, Nov. 1985 - Apr. 1988**
C. W. Fairall, D. W. Thomson, and W. J. Syrett 1988 75 p
(Grant AF-AFOSR-0049-86; AF Proj. 2310)
(AD-A198313; AFOSR-88-0778TR) Avail: NTIS HC A04/MF A01 CSCL 04A

This project studied the relation of meteorological conditions to parameters and processes that influence the optical propagation properties establishment of a climatology of refractive index structure function parameter as measured with a network of Doppler radars. The relation of the atmospheric turbulence profile to the synoptic context and physical models to predict the profile using standard meteorological profile data was also being investigated. The study features two modes of data archiving: (1) continuous archiving of 1 hr average wind profiles and turbulence levels, and (2) high time resolution measurements in association with other measurements (ground-based optical scintillometers, aircraft or radiosondes). The atmospheric turbulence profiles and resultant optical propagation parameters have been found to be strongly influenced by synoptic conditions. In particular, the turbulence was

substantially affected by to strength and location of the jetstream. A very strong correlation between wind shear (which was maximum above and below the core of the jet) and pilot reports of turbulence was found. Richardson number gave a much weaker indication, possibly because of the poorer quality of the vertical temperature gradient data. GRA

**N89-14627#** Michigan Univ., Ann Arbor. Space Physics Research Lab.
**INVESTIGATIONS OF THE DYNAMICS AND THERMODYNAMICS OF THE MESOSPHERE AND UPPER THERMOSPHERE AT THE POLAR REGIONS Final Report, 1 Apr. 1987 - 31 Mar. 1988**
G. Hernandez 1 Jun. 1988 10 p Prepared in cooperation with Washington Univ., Seattle
(Grant AF-AFOSR-0174-87; AF Proj. 2310)
(AD-A198463; AFOSR-88-0905TR) Avail: NTIS HC A02/MF A01 CSCL 04A

The instrumentation at the Poker Flat (Alaska) field site has been made operational in teleautonomous mode. This application of telescience principles has allowed long-wire operation of the multiple-beam spectrometer at the field site, and makes it possible to efficiently obtain further observations of the dynamics and thermodynamics of the upper thermosphere. These observations have been used to show the lowest latitude at which the y-component of the IMF (Interplanetary Magnetic Field) distorts the classical two-cell convection cell in the upper thermosphere. The first simultaneous measurements of the dynamics and thermodynamics of the polar mesosphere show large fluctuations in the wind field and seem to be associated with temperature fluctuations. At this time, we were able to monitor a mesospheric event, characterized by a large decrease of the emission rate of the emissions from this region. A double-etalon modulator (DEM) has been theoretically developed and its properties have been experimentally confirmed. The DEM is a compensated device with nearly 100 times the luminosity of presently available spectrometers. GRA

**N89-14628#** Titan Systems, Inc., La Jolla, Calif.
**DAYLIGHT AND TWILIGHT SKY RADIANCE AND TERRESTRIAL IRRADIANCE**
C. H. Waldman Jan. 1988 25 p
(Contract N66001-84-D-0009)
(AD-A198550; NOSC/TD-1226) Avail: NTIS HC A03/MF A01 CSCL 04A

When solar radiation is transmitted through the atmosphere it may be reflected, transmitted, or absorbed. The total effect of the atmosphere upon a beam of sunlight passing through it is to reduce its intensity by amounts varying with latitude, season, and degree of cloudiness. The atmosphere weakens solar energy through molecular and small particle scattering, diffuse reflection by larger particles, and selective absorption as due to ozone and water vapor. The scattering and reflecting processes send a part of the solar energy back into space, but some of it reaches the earth's surface as diffuse sunlight. A model for the sky radiance and terrestrial irradiance is developed and a computer program was written to carry out the calculation. GRA

**N89-14629** National Physical Lab., Teddington (England). Div. of Mechanical and Optical Metrology.
**THE PRECISE DETERMINATION OF THE REFRACTIVE INDEX OF AIR**
K. P. Birch and M. J. Downs Jul. 1988 39 p
(NPL-MOM-90; ISSN-0309-3069; ETN-89-93572) Copyright
Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

Determination of the refractive index of air by direct measurement and using either the equations of Edlen or of Owens is discussed. The equations were examined over a wide range of ambient conditions and an error in the water vapor term is identified. A modified Edlen equation which has an estimated uncertainty of + or - 3.3 times 10 to the minus 8th power was developed. The values calculated from the modified equation, which were corrected for ambient CO2 levels above the 300 ppm normally assumed by Edlen, are found to agree with those obtained by direct measurement to within the experimental uncertainty. ESA

**N89-14630#** Physics and Electronics Lab. TNO, The Hague (Netherlands).
**OPTICAL AND INFRARED PROPERTIES OF THE MARINE ATMOSPHERE, PHASE 1 Final Report**
G. deLeeuw Sep. 1987 104 p In DUTCH; ENGLISH summary
(Contracts A79/KM/075; A86/KM/103)
(FEL-1987-76; TD-87-5906; ETN-89-93412) Avail: NTIS HC A06/MF A01

Measurements to characterize and model the electrooptical properties of the marine atmosphere are surveyed. Aerosol and lidar measurements were conducted from ships, platforms and aircraft. Profiles of particle size distributions, light scattering, and relative humidity were determined down to close to the sea surface; the mixing layer was characterized by lidar measurements. The results contribute significantly to a better understanding of the processes occurring in the marine atmosphere. The analysis of the transmission characteristics in the visible and IR shows relations with meteorological parameters, as well as too many gaps in the present knowledge, i.e., too little experimental data to allow physical and electrooptical modeling of the marine atmosphere. ESA

**N89-14631** Royal Netherlands Meteorological Inst., De Bilt. Afdeling Fysische Meteorologie.
**AUTOMATIC DETECTION OF INVERSIONS USING SODAR [AUTOMATISCHE DETEKTIE VAN INVERSIES MET SODAR]**
Anton C. M. Beljaars and Rob Agterberg 1988 24 p In DUTCH
(KNMI-TR-106; ISSN-0169-1708; ETN-89-93581) Copyright
Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 De Bilt, Wilhelminalaan 10, Netherlands

An automatic detection system for the conversion of digital sodar measurements into a coding for the type and the height of temperature inversions and of the presence of convection, is presented. The system contains a microprocessor that determines the echo intensity as a function of height and averages over fifty pulses, as well as pattern recognition software allowing the determination of the inversion heights from the intensity profiles. The results of the automatic detection were compared with a subjective manual coding of facsimile registrations. The agreement is very good in clear situations. In less clear situations the agreement is worse, and the automatic scheme has a tendency to code no detection. The advantage of automatic detection is that the coded information can be sent to and stored in a data base. ESA

**N89-14632** Royal Netherlands Meteorological Inst., De Bilt. Afdeling Seismologie.
**GEOMAGNETIC SURVEY OF THE NETHERLANDS, REDUCED TO 1985 [OPMETING VAN HET AARDMAGNEETVELD IN NEDERLAND, HERLEID NAAR 1985]**
J. R. Rietman Jul. 1988 47 p In DUTCH; ENGLISH summary
(KNMI-TR-109; ISSN-0169-1708; ETN-89-93584) Copyright
Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 De Bilt, Wilhelminalaan 10, Netherlands

The results of the geomagnetic survey of the Netherlands, carried out during the period 1985-1987 are presented. Observation methods, instrumentation, and processing and accuracy of the measurements are discussed. The observations were reduced with reference to the geomagnetic Witteveen Observatory to 1985. For the declination, the total intensity, and the intensity of the components, the differences with the corresponding values at the Witteveen Observatory are presented. ESA

**N89-14633#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Atmosphaerische Dynamik.
**TURBULENCE STRUCTURE OF ARCTIC STRATUS CLOUDS DERIVED FROM MEASUREMENTS AND SIMULATIONS Ph.D. Thesis - Ludwig-Maximilians-Univ.**
Joerg E. Finger Aug. 1988 89 p In GERMAN; ENGLISH summary
(DFVLR-FB-88-29; ISSN-0171-1342; ETN-89-93658) Avail: NTIS HC A05/MF A01; original version available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 27.50 Deutsche marks

The vertical structure of the Arctic planetary boundary layer was investigated. This boundary layer includes an extensive field of stratus clouds in its upper part. The profiles of the mean meteorological variables, and the vertical turbulent mixing processes, controlled by the turbulent kinetic energy were analyzed. The results of aircraft measurements as well as of numerical simulations by a one-dimensional turbulence model are compared. The radiative cooling at cloud top is identified to be the dominant process controlling the whole turbulence structure for the case of quasi-stationarity. ESA

**N89-15027*#** Arizona State Univ., Tempe. Dept. of Geology.
**ELECTROSTATIC AGGREGATION OF FINELY-COMMINUTED GEOLOGICAL MATERIALS**
John R. Marshall and Ronald Greeley *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p Previously announced as N86-27156 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 08G

**N89-15029*#** Guelph Univ. (Ontario).
**THE INITIATION OF GRAIN MOVEMENT BY WIND**
William G. Nickling *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p Previously announced as N86-27157 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 04A

# 47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

**N89-14634*#** National Aeronautics and Space Administration, Washington, DC.
**SUMMARY OF ALONG-TRACK DATA FROM THE EARTH RADIATION BUDGET SATELLITE FOR SEVERAL REPRESENTATIVE OCEAN REGIONS**
David R. Brooks and Marta A. Fenn (Planning Research Corp., Hampton, Va.) Nov. 1988 216 p
(NASA-RP-1206; L-16449; NAS 1.61:1206) Avail: NTIS HC A10/MF A01 CSCL 04B

For several days in January and August 1985, the Earth Radiation Budget Satellite, a component of the Earth Radiation Budget Experiment (ERBE), was operated in an along-track scanning mode. A survey of radiance measurements taken in this mode is given for five ocean regions: the north and south Atlantic, the Arabian Sea, the western Pacific north of the Equator, and part of the Intertropical Convergence Zone. Each overflight contains information about the clear scene and three cloud categories: partly cloudy, mostly cloudy, and overcast. The data presented include the variation of longwave and shortwave radiance in each scene classification as a function of viewing zenity angle during each overflight of one of the five target regions. Several features of interest in the development of anisotropic models are evident, including the azimuthal dependence of shortwave radiance that is an essential feature of shortwave bidirectional models. The data also demonstrate that the scene classification algorithm employed by the ERBE results in scene classifications that are a function of viewing geometry. Author

**N89-14635** Wisconsin Univ., Madison.
**CLASSIFICATION AND ANALYSIS OF SURFACE AND CLOUDS AT HIGH LATITUDES FROM AVHRR MULTISPECTRAL SATELLITE DATA Ph.D. Thesis**
Elizabeth Eby Ebert 1987 193 p
Avail: Univ. Microfilms Order No. DA8800706

Measurement of polar cloud cover is important because of its strong radiative influence on the energy balance of the snow and ice surface. However, conventional satellite cloud detection schemes often fail in the polar regions because of small visible and thermal contrasts. Some of these limitations were overcome by a pattern recognition algorithm which uses visible, near-infrared, and infrared Advanced Very High Resolution Radiometer (AVHRR) satellite data to identify regions of various surface and cloud types at high latitudes. For each of the four periods (Arctic summer, Arctic winter, Antarctic summer, Antarctic winter) approximately 1000 training samples were used to teach the algorithm the spectral and textural characteristics of 18 surface and cloud classes. The algorithm then combines the classification information with a hybrid histogram-spatial coherence analysis to estimate the fractional cloud cover, as well as clear and cloudy albedos and brightness temperatures. The hybrid histogram-spatial coherence method accurately analyzed sixty artificial scenes which had known values of cloud fraction and surface and cloud properties. Two days of polar AVHRR data from 6 January 1984 and 1 July 1984 were analyzed. Dissert. Abstr.

**N89-14636** Texas Technological Univ., Lubbock.
**THE DESIGN AND PROTOCOL OF A SUMMERTIME RAINFALL ENHANCEMENT PROGRAM FOR WEST TEXAS Ph.D. Thesis**
Eric Andrew Pani 1987 264 p
Avail: Univ. Microfilms Order No. DA8806020

Original analyses of data collected during three rainfall enhancement experiments are combined with other individual studies to assess the state of knowledge about rainfall enhancements in West Texas. The small, multiple-cell convection system is chosen for study because treating it offers the potential for significantly increasing growing-season rainfall in the region. Geostationary Operational Environmental Satellite (GOES) images are used to develop a climatology of the frequency, location, and timing of the small, multiple-cell convective system formations within 150 km of Big Spring, TX. The small, multiple-cell convective system is initiated in a moist, conditionally-unstable atmosphere by weak forcing mechanisms. Microphysical characteristics of the clouds are highly variable and lead to the conclusion that data in addition to those which already exist are needed before the precipitation process in the clouds is sufficiently understood to be altered in a verifiable manner. The relationship between rainfall rate and radar reflectivity factor in the small, multiple-cell convective system is examined considering the effects of evaporation and horizontal transport of rainfall. A field experiment is designed for sampling of the small, multiple-cell convective system with Doppler radars and instrumented aircraft. Dissert. Abstr.

**N89-14637*#** Kansas State Univ., Manhattan. Div. of Biology.
**THE INFLUENCE OF GRAZING ON LAND SURFACE CLIMATOLOGICAL VARIABLES Semiannual Report**
T. R. Seastedt and M. I. Dyer (Biosphere Research, Inc., Lenoir City, TN.) 28 Oct. 1988 53 p
(Grant NAG5-897)
(NASA-CR-183308; NAS 1.26:183308) Avail: NTIS HC A04/MF A01 CSCL 04B

Research accomplishments in empirical measurements, laboratory analyses, data analyses, and modeling are summarized. Publications are listed. Presentations made during the funding period are also listed. B.G.

**N89-14638#** Melbourne Univ., Parkville (Australia). Dept. of Meteorology.
**CLIMATOLOGY OF THE MELBOURNE UNIVERSITY GENERAL CIRCULATION MODEL**
Ian Simmonds, Glenn Trigg, and Rachel Law Jan. 1988 72 p

(PB88-227491; ISBN-0-86839-8829; Publ-31) Avail: NTIS HC A04/MF A01 CSCL 04B

The climatology of the Melbourne University Climate Model is presented and compared with observed climatology. Most of the meteorological elements commonly considered when evaluating the quality of general circulation models are used. The model was derived from a hemispheric version of an earlier model. Several modifications have been made to the physics of the model and the structure of the code and description of some of these is included. GRA

**N89-14639#** National Center for Atmospheric Research, Boulder, CO.

**SEMI-PROGNOSTIC TESTS OF CUMULUS PARAMETERIZATION SCHEMES IN THE MIDDLE LATITUDES Ph.D. Thesis - Miami Univ.**

Georg A. Grell 1988 251 p Prepared in cooperation with Miami Univ., Coral Gables, FL

(Grant NSF ATM-87-09659)

(PB88-236013; NCAR/CT-114) Avail: NTIS HC A12/MF A01 CSCL 04B

The Center tested cumulus parameterizations directly with observations. Answers were sought for the following issues: (1) the effectiveness of cumulus parameterization schemes in the mid-latitude environment of severe convective storms; (2) the validity of fundamental closure assumptions made by various schemes in the mid-latitudes; and (3) the qualitative nature of parameterization errors. In order to establish a common base upon which to compare various assumptions of different parameterization schemes, the terminology introduced by Schubert (1974) which breaks down cumulus parameterization, from a modeling point of view into dynamic control, static control, and feedback, is used. The Center also reviewed the interaction between convection and the environment, as well as various methods of parameterizing cumulus convection using the framework. The methodology and structure are described. GRA

**N89-14640#** National Center for Atmospheric Research, Boulder, CO. Climate and Global Dynamics Div.

**IMPLICIT NORMAL-MODE INITIALIZATION OF THE PSU/NCAR (PENNSYLVANIA STATE UNIVERSITY/NATIONAL CENTER FOR ATMOSPHERIC RESEARCH) MESOSCALE MODEL**

Ronald M. Errico and Gary T. Bates Jun. 1988 124 p Sponsored in part by EPA, Washington and Geological Survey, Reston, VA

(Grant NSF ATM-87-09659)

(PB88-126021) Avail: NTIS HC A06/MF A01 CSCL 04B

A contribution is described to the Pennsylvania State Univ./NCAR Mesoscale Model. The primary purpose of the contribution is to provide more realistic initial data for use by that model. The software was designed for use with the Pennslyvania State Univ./NCAR Mesoscale Model designated MM4, although it is easily adaptable to other models. In addition to its function with initial data, it may be used as a diagnostic tool to investigate the model's behavior. The contribution replaces an earlier report which had an incorrect linearization of the hydrostatic equation. Effects of that error were minimal regarding nonlinear initialization, but were gross for linear initialization. Differences between the old and new reports are summarized in Appendix 1. Author

**N89-14641#** Pacific Northwest Labs., Richland, Wash.

**THE DATA COLLECTION COMPONENT OF THE HANFORD METEOROLOGY MONITORING PROGRAM**

C. S. Glantz and M. M. Islam Sep. 1988 221 p

(Contract DE-AC06-76RL-01830)

(DE89-000404; PNL-6684) Avail: NTIS HC A10/MF A01

An intensive program of meteorological monitoring is in place at the U.S. Department of Energy's Hanford Site. The Hanford Meteorology Monitoring Program involves the measurement, observation, and storage of various meteorological data; continuous monitoring of regional weather conditions by a staff of professional meteorologists; and around-the-clock forecasting of weather conditions for the Hanford Site. The objective of this report is to document the data collection component of the program. In this report, each meteorological monitoring site is discussed in detail. Each site's location and instrumentation are described and photographs are presented. The methods for processing and communicating data to the Hanford Meteorology Station are also discussed. Finally, the procedures followed to maintain and calibrate these instruments are presented. DOE

**N89-14642#** Calspan Advanced Technology Center, Buffalo, NY.

**AEROSOL CHARACTERISTICS IN THE MARINE BOUNDARY LAYER OVER THE STRAITS OF GIBRALTAR, JUNE 1986 Final Report, May 1986 - Dec. 1987**

B. J. Wattle and C. W. Rogers Apr. 1988 87 p

(Contract N00014-85-C-2393)

(AD-A197945; NEPRF-CR-88-03) Avail: NTIS HC A05/MF A01 CSCL 04B

Measurements of aerosol characteristics in the marine boundary layer were taken during a two-week cruise through the Straits of Gibraltar. Observations of Aitken nuclei concentration, aerosol size spectra (0.01 to 100 micron diameter), aerosol composition, visibility (scattering coefficient), optical depth (sun photometry), temperature, humidity, winds and cloud cover were acquired during daylight hours. The data show that surface visibility fluctuations correlate well with particle concentration in the 0.56 to 1.78 micron size range. Surface relative humidity and particle composition appear to be the factors that control concentration in this size range. These data will be used as ground truth for techniques which retrieve aerosol data from satellites. This experiment was well suited for such an application, since there was little cloud cover to obscure satellite measurements, and comprehensive, consistent aerosol measurements were successfully taken. GRA

**N89-14643#** Manchester Univ. (England). Dept. of Pure and Applied Physics.

**FIELD TESTS AND EXPERIMENTS ON VISIBILITY MODIFICATION Final Report**

J. Latham, M. H. Smith, and I. E. Consterdine Jul. 1988 50 p

(Contract DAJA45-86-C-0001)

(AD-A197956; R/D-5043-EN-01) Avail: NTIS HC A03/MF A01 CSCL 04B

Laboratory experiments on the scavenging of wet aerosol - of controlled sizes ranging from about 0.3 to 50 micrometers - by electrically charged collector drops have been performed. The consistent result was of a pronounced increase in measured values of collection efficiency above those found in the absence of electrical forces. Water drops of characteristic size around 0.1mm, carrying charges of several tenths of the Rayleigh limit, swept out essentially uncharged water droplets of size within the condensate size-band for fogs, with collection efficiencies E in the range approximately 20 to 25 (the corresponding nonelectrical values are significantly less than unity). A crude theoretical model of the capture process provided values of E in reasonable agreement with those measured. The principal of the technique would be to introduce highly charged drops into a fog. These would scavenge fog droplets with great efficiency - as indicated in the laboratory experiments - and the collector drops (now much larger, having swept out large numbers of fog droplets) would settle from the fog under the influence of gravity, leaving it with a substantially reduced liquid water content - and correspondingly enhanced visibility. GRA

**N89-14644#** Air Force Inst. of Tech., Wright-Patterson AFB, OH.

**SOME WIND CHARACTERISTICS OF KAHE POINT, O'AHU AND VICINITY M.S. Thesis**

Norbert R. Cordeiro Aug. 1988 126 p

(AD-A197969; AFIT/CI/NR-88-185) Avail: NTIS HC A07/MF A01 CSCL 04B

A description of some surface wind characteristics of Kahe Point, O'ahu and vicinity is presented. Over the long-term, winds are found to be bimodal. Nocturnal winds tend to be persistent tradewinds while daytime westerlies are occasionally observed.

Windroses and diurnal variation of long-term resultant mean winds are presented in tabular format and discussed. Divergence calculations obtained from the least-squares method show divergence is associated with nighttime hours while convergence is associated with daytime hours. Local winds are observed in the form of sea-breeze and drainage-wind systems. Some aspects of these systems have been analyzed over a three-month period. Drainage is best developed during episodes of light ambient winds and clear skies and easily yields to synoptic winds. Sea-breeze circulation interaction with prevailing winds is found to be in good agreement with earlier numerical results of Estoque (1962). Hodographs display clockwise rotation about fifty-percent of the time while anti-clockwise rotation is observed one-tenth of the time. GRA

**N89-14645#** Naval Postgraduate School, Monterey, CA.
**A STUDY OF A RAPID CYCLOGENESIS EVENT DURING GALE M.S. Thesis**
Jeffrey L. Carson Jun. 1988 73 p
(AD-A198555) Avail: NTIS HC A04/MF A01 CSCL 04B

An explosive cyclone that developed during intensive observation period (IOP)9 of the Genesis of Atlantic Lows Experiment (GALE) is studied. Detailed surface analysis is conducted based on operationally available data, late reporting ship observations and special observations acquired by GALE scientists to determine the surface storm track and deepening rate. GALE dropsonde and rawinsonde data are used to supplement the normal upper-level data base, and are analyzed by the Navy Operational Regional Analysis and Prediction System (NORAPS) using optimal interpolation objective analysis. These analysis are discussed with special emphasis given to possible factors contributing to the explosive cyclogenesis. Factors that influenced the cyclone's rapid development include upper-level positive vorticity advection, low-level warm temperature advection and low-level instability. Vertical soundings and cross-sections utilizing the dropsonde and rawinsonde data are used to study the environment in which the rapidly deepening cyclone initially developed. GRA

**N89-14646** Royal Netherlands Meteorological Inst., De Bilt. Physical Meteorology Dept.
**THE MEASUREMENT OF GUSTINESS AT ROUTINE WIND STATIONS: A REVIEW**
Anton C. M. Beljaars 1987 55 p
(KNMI-WR-87-11; WMO-31; B8736763; ISSN-0169-1651; ETN-89-93576) Copyright Avail: Royal Netherlands Meteorological Institute, P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, The Netherlands

Specifications for the measurement of wind gustiness are proposed. User requirements are reviewed and the consequences for the measuring system are discussed. It is important to observe wind extremes in a uniform way and such that the results can be used directly in wind load studies. Gustiness measurements can be used to characterize the exposure error of wind stations. The gustiness of the wind is a measure of the turbulence intensity which is directly related to the roughness of the upstream terrain. This information enables the correction of means wind observations for local perturbations. Application of such procedures would greatly enhance the quality of surface wind observations over land. The best gustiness parameters for this application are the standard deviation of wind speed and wind direction. It is recommended to measure these parameters on a routine basis. ESA

**N89-14647** Royal Netherlands Meteorological Inst., De Bilt. Physical Meteorology Dept.
**DESCRIPTION OF THE CABAUW (NETHERLAND) TURBULENCE DATASET 1977-1979**
C. Hofman 1988 24 p
(KNMI-TR-105; B8821590; ISSN-0169-1708; ETN-89-93580) Copyright Avail: Royal Netherlands Meteorological Institute, P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, The Netherlands

A data set from a meteorological mast concerning atmospheric turbulence is described. Radio sondes are also used. ESA

**N89-14648*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**USER'S GUIDE FOR THE NIMBUS 7 SCANNING MULTICHANNEL MICROWAVE RADIOMETER (SMMR) CELL-ALL TAPE**
C. C. Cu, D. Han, S. T. Kim (ST Systems Corp., Lanham, Md.), and P. Gloersen Oct. 1988 152 p
(Contract NAS5-29386)
(NASA-RP-1210; Rept-88-181; NAS 1.61:1210) Avail: NTIS HC A08/MF A01 CSCL 04B

The SMMR instrument onboard the Nimbus-7 satellite has been in operation since October 1978. It provided global coverage of passive microwave observations at 6.6, 10.7, 18, 21, and 37 GHz. The oberved brightness temperature can be used to retrieve geophysical parameters, principally sea surface temperature, atmospheric water vapor and liquid water content over oceans, sea ice concentration, and snow cover over land. The SMME CELL-ALL Tape contains earth-located calibrated brightness temperature data which have been appropriately binned into cells of various grid sizes, allowing intercomparisons of observations made at different frequencies (with corresponding different footprint sizes). This user's guide describes the operation of the instrument, the flow of the data processing the calibration procedure, and the characteristics of the calibrated brightness temperatures and how they are binned. Detailed tape specifications and lists of available data are also provided. Author

**N89-14649** Royal Netherlands Meteorological Inst., De Bilt. Afdeling Dynamische Meteorologie.
**NUMERICAL ATMOSPHERIC MODELS [NUMERIEKE ATMOSFEERMODELLEN]**
A. P. M. Baede 1988 81 p In DUTCH
(KNMI-TR-107; ISSN-0169-1708; ETN-89-93582) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 De Bilt, Wilhelminalaan 10, Netherlands

The fundamentals of numerical atmospheric models are treated. Data, data control, data selection, and data assimilation are introduced. The physics laws and their simplified versions are given. The linear as well as the nonlinear advection equations are outlined. Coordinate systems and three-dimensional schemes are presented. A model in pressure coordinates is introduced. The physical parameterizations are discussed. Performances and predictability of numerical atmospheric models are outlined. ESA

**N89-14650** Royal Netherlands Meteorological Inst., De Bilt. Afdeling Dynamische Meteorologie.
**FITTING OF METEOSAT INFORMATION INTO METEOROLOGICAL DECISION MAKING [INPASSING VAN METEOSAT INFORMATIE IN DE METEOROLOGISCHE BESLUITVORMING]**
J. Roodenburg 1988 36 p In DUTCH
(KNMI-TR-108; ISSN-0169-1708; ETN-89-93583) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 De Bilt, Wilhelminalaan 10, Netherlands

The integration of Meteosat data in the operational decision making process is outlined. The different meteorological satellites are compared. The different Meteosat channels, each covering a wavelength domain, are given. It is explained what the different channels can observe and how the images can be manipulated. Practical applications are discussed, in short-term as well as long-term weather forecasting. ESA

**N89-14651*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**A STUDY FOR SYSTEMATIC ERRORS OF THE GLA FORECAST MODEL IN TROPICAL REGIONS**
Tsing-Chang Chen, Wayman E. Baker, James Pfaendtner, and Martin Corrigan (Iowa State Univ. of Science and Technology, Ames.) 3 Jan. 1988 11 p

(Grant NAG5-355)
(NASA-TM-101194; NAS 1.15:101194) Avail: NTIS HC A03/MF A01 CSCL 04B

From the sensitivity studies performed with the Goddard Laboratory for Atmospheres (GLA) analysis/forecast system, it was revealed that the forecast errors in the tropics affect the ability to forecast midlatitude weather in some cases. Apparently, the forecast errors occurring in the tropics can propagate to midlatitudes. Therefore, the systematic error analysis of the GLA forecast system becomes a necessary step in improving the model's forecast performance. The major effort of this study is to examine the possible impact of the hydrological-cycle forecast error on dynamical fields in the GLA forecast system. Author

**N89-14899*#** State Univ. of New York, Brockport. Dept. of the Earth Sciences.
**USE OF THE TERMINAL AREA SIMULATION SYSTEM (TASS) TO STUDY MICROBURST WIND SHEARS**
Gregory P. Byrd *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 44-45 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 04B

**N89-14931*#** South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Science.
**TEXTURE-BASED CLOUD CLASSIFICATION Abstract Only**
Ronald M. Welch *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 106-107 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 04B

# 48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

**N89-14652#** Proudman Oceanographic Lab., Birkenhead (England).
**FEASIBILITY STUDY FOR THE DEVELOPMENT OF A JOINT SURGE AND WAVE MODEL**
J. Wolf, K. P. Hubbert, and R. A. Flather 1988 108 p
(PB88-230917; Rept-1) Avail: NTIS HC A06/MF A01 CSCL 08C

A preliminary investigation of the interactions between surface waves and the longer period motions due to tides and surges was conducted. The aim is to study the feasibility of developing a combined model of tides, surges and waves with particular application to flood prediction. The theoretical background of the interactions between tide and surge motion and the surface waves is summarized. The modified equations for the conservation of momentum for tide and surge motion and conservation of wave spectral energy density are derived. Some calculations of the magnitude of the interaction terms were made using results of existing surge/tide and wave models. Author

**N89-14653*#** Miami Univ., Coral Gables, FL.
**HEAT FLOW AND MAGNETIZATION IN THE OCEANIC LITHOSPHERE Ph.D. Thesis Semiannual Report, Nov. 1987 - Apr. 1988**
Kjell Lennart Hayling 1988 130 p
(Grant NAG5-414)
(NASA-CR-183346; NAS 1.26:183346) Avail: NTIS HC A07/MF A01 CSCL 08C

Two aspects of the processing and interpretation of satellite measurements of the geomagnetic field are described. One deals with the extraction of the part of the geomagnetic field that originates from sources in the earth's atmosphere. The other investigates the possibility of using the thermal state of the oceanic lithosphere to further constrain modelling and interpretation of magnetic anomalies. It is shown that some of the magnetic signal in crustal anomaly maps can be an artifact of the mathematical algorithms that have been used to separate the crustal field from the observed data. Strong magnetic anomalies can be distorted but are probably real, but weak magnetic anomalies can arise from leakage of power from short wavelengths, and will also appear in anomaly maps as repetitions of the strong crustal anomaly. The distortion and the ghost anomalies follow the magnetic dip lines in a way that is similar to actual MAGSAT anomaly fields. This phenomenon will also affect the lower degree spherical harmonic terms in the power spectrum of the crustal field. A model of the magnetic properties of the oceanic crust that has been derived from direct measurements of the rock magnetic properties of oceanic rocks is presented. The average intensity of magnetization in the oceanic crust is not strong enough to explain magnetic anomalies observed over oceanic areas. This is the case for both near surface observations (ship and aeromagnetic data) and satellite altitude observations. It is shown that magnetic sources in the part of the upper mantle that is situated above the Curie isotherm, if sufficiently strong, can produce satellite magnetic anomalies that are comparable to MAGSAT data. The method developed for the study of depth to the Curie isotherm and magnetic anomalies can also be used in inverse modelling of satellite magnetic anomalies when the model is to be adjusted with an annihilator. Author

**N89-14654#** Naval Ocean Research and Development Activity, Bay St. Louis, MS. Ocean Sensing and Prediction Div.
**THE ROLE OF HORIZONTAL PROCESSES IN UPPER-OCEAN PREDICTION: A FORECAST SIMULATION IN THE SEA OF JAPAN Ph.D. Thesis. Final Report**
John M. Harding, Jr. Aug. 1988 250 p
(AD-A198827; NORDA-190) Avail: NTIS HC A11/MF A01 CSCL 08C

Present-day, operational, upper-ocean, thermal-structure forecast models consist of mixed layer models with local wind-generated horizontal and vertical advection. To extend their applicability into dynamically active regions, e.g., western boundary current regions, the next generation ocean models are envisioned to include mesoscale advection provided by high horizontal resolution circulation nowcast and, eventually, forecast models. This study considers the impact of this additional component for advection in a representative dynamic ocean region. Four experiments were performed using a modified version of an operational, upper-ocean, thermal prediction model. Each consisted of a series of daily, 72-hour-duration, upper-ocean hindcasts and was conducted for 4 weeks during the warming season in the Sea of Japan. The first experiment used an N x 1-dimensional mixed-layer model with no horizontal and vertical advection. The 3rd, repeated the 2nd, with the addition of a fixed geostrophic component to the horizontal advection. The 4th allowed daily variation of the geostrophic component through each 3-day forecast. Statistical measures applied to the results indicated a small but statistically significant increase in forecast skill due to the addition of the nowcast mesoscale advection. GRA

**N89-14655#** Naval Ocean Research and Development Activity, Bay St. Louis, MS.
**CHEMICAL VARIABILITY IN OCEAN FRONTAL AREAS Final Report**
Denis A. Wiesenburg and Dana A. Kester Jul. 1988 27 p
Presented at a workshop on Biological and Chemical Processes at Oceanic Fronts, Bay St. Louis, MS, 19-22 Sep. 1983
(AD-A198418; NORDA-SP-035; Rept-333; Rept-88) Avail: NTIS HC A03/MF A01 CSCL 08C

Between 19 and 22 September 1983, over 50 scientists met at the Naval Ocean Research and Development Activity (NORDA) to discuss issues related to the study of biological and chemical processes at oceanic fronts. In lieu of the publication of NORDA Report 78, this document has been printed to distribute the abstracts of the meeting. It was evident from the discussion of

this workshop that rapid progress could be made in understanding chemical variability and processes at fronts, if a coordinated plan of research is pursued. The scope of the work to be done is multidisciplinary and extensive; this is a problem that would benefit greatly from a long-range, multi-investigator, coordinated study. The major components of such an investigation would include: (1) satellite and aircraft remote sensing, (2) physical characterization of the frontal system and its exchange processes, (3) measurements of chemical gradients and rates for substances participating in biological, photochemical, and solid phase processes, and (4) determination of the abundance and rates of biological activity associated with a front. It is likely that there is a wide range of frontal systems in the ocean that need to be distinguished. A coordinated investigation would provide the greatest advancement of knowledge for a given investment of resources. GRA

**N89-14656#** SACLANT ASW Research Center, La Spezia (Italy). Undersea Research Center.
**QUALITATIVE ASPECTS OF SEISMOGRAPH/OCEAN BOTTOM INTERACTION**
M. Snoek and R. Herber Jun. 1988 27 p
(AD-A198652; SACLANTCEN-SM-206) Avail: NTIS HC A03/MF A01 CSCL 17J

The parameters affecting the coupling of the Ocean Bottom Seismometer to the ground have been studied in a controlled experiment in the large seawater test pit of the Centre Oceanologique de Bretagne, France. An outline of the experiment is presented and an attempt is made to understand the processes involved and relate them to a simple physical mechanism. Examples of sensor performance are given and basic ideas for the design of sensors in general and ground interacting elements are presented. GRA

**N89-14657** Royal Netherlands Meteorological Inst., De Bilt. Afdeling Oceanografisch Onderzoek.
**ENERGY DISSIPATION OF MONOCHROMATIC SEA WAVES IN THE TURBULENT BOUNDARY LAYER [ENERGIEDISSIPATIE VAN MONOCHROMATISCHE ZEEGOLVEN IN DE TURBULENTE BODEMGRENSLAAG]**
Marijke Visser Jan. 1988 68 p In DUTCH
(KNMI-TR-104; ISSN-0169-1708; ETN-89-93579) Copyright Avail: Royal Netherlands Meteorological Inst., P.O. Box 201, 3730 De Bilt, Wilhelminalaan 10, Netherlands

Wave motion in shallow water is treated in order to calculate the energy dissipation of monochromatic waves in the turbulent surface boundary layer. Two parameterizations of the turbulence are presented: the drag law and the linear eddy viscosity model. The dependence of the energy dissipation and other quantities on the different parameters were examined. For a given turbulence level the drag law leads to higher dissipations than the eddy viscosity model. The friction factor, calculated using a velocity profile with Kelvin functions, is larger than that calculated with logarithmic velocity profile approximations; the difference increases with surface roughness. The energy dissipation, calculated with the eddy viscosity model for realistic surface roughness values, is in reasonable agreement with the results of measurements performed in the southern North Sea. ESA

## 51 LIFE SCIENCES (GENERAL)

**N89-14658#** Joint Publications Research Service, Arlington, VA.
**JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: LIFE SCIENCES**
4 Aug. 1987 204 p Transl. into ENGLISH from various Russian articles
(JPRS-ULS-87-008) Avail: NTIS HC A10/MF A01

JPRS Report ULS-87-008 of 4 August 1987: Science and Technology; USSR: Life Sciences, contains reports on the following: hypokinesia, muscle tissue, gas metabolism, myocardium, hypoxia, and hemodynamic responses. For individual titles, see N89-14659 through N89-14665.

**N89-14659#** Joint Publications Research Service, Arlington, VA.
**EFFECTS OF CALCITONIN AND RETABOLIL ON RAT FEMUR IN HYPOKINESIA Abstract Only**
I. V. Rogacheva *In its* JPRS Report: Science and Technology. USSR: Life Sciences 4 Aug. 1987 p 1 Transl. into ENGLISH from Patologicheskaya Fiziologiya i Eksperimentalnaya Terapiya (Moscow, USSR), no. 4, Jul. - Aug. 1986 p 53-56 (For primary document see N89-14658 06-51)
Avail: NTIS HC A10/MF A01

Therapeutic trials were conducted with calcitonin and Retabolil (nandrolone decanoate) in the case of femoral osteoporosis induced by immobilization in Wistar rats (180 to 200 g). Immobilization consisted of support elimination by tibial amputation. In the control animals immobilization led to diminished femoral growth, thinning of cortical layers, and frank osteoporosis. Animals treated with either calcitonin (2 U MRC, S.C, every other day) or Retabolil (0.2 ml, once every 10 days) for 40 days did not present any evidence of improvement in terms of underlying femoral changes. However, administration of a combination of calcitonin + Retabolil prevented further atrophy of the femur. The effectiveness of the combined therapy was attributed to prevention of bone protein catabolism by Retabolil and of mineral loss by calcitonin. Author

**N89-14660#** Joint Publications Research Service, Arlington, VA.
**HOLOGRAPHIC RECORDING OF DEFORMATION WAVES IN MUSCLE TISSUE Abstract Only** **c52**
V. S. Sinyakov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 4 Aug. 1987 p 13 Transl. into ENGLISH from Byulleten Eksperimentalnoy Biologii i Meditsiny (Moscow, USSR), v. 102, no. 10, Oct. 1986 p 495-498 (For primary document see N89-14658 06-51)
Avail: NTIS HC A10/MF A01

Waves were recorded by two methods: static and dynamic. The static method involved measuring the bending of the surface of the muscle as a function of static force acting on the muscle through a circular stamp. In the dynamic studies, a shear deformation wave was created, the profile of which was recorded by holographic interferometry. The interferograms revealed that at frequencies from 200 to 500 Hz the vibrator creates deformation waves which penetrate into the muscle tissue deeply enough to be used to study the muscle tissues, the skin having practically no influence on the interference picture. The method is suitable for investigation of the biomechanical properties of human muscles and, also, for determination and investigation of heterogeneities in any elastic-viscous material. Author

**N89-14661#** Joint Publications Research Service, Arlington, VA.
**INFLUENCE OF HIGH TEMPERATURE ON TOTAL GAS METABOLISM OF ANIMALS WITH LIMITATION OF MOTOR ACTIVITY Abstract Only**
R. M. Kafizova *In its* JPRS Report: Science and Technology. USSR: Life Sciences 4 Aug. 1987 p 66 Transl. into ENGLISH from Uzbekskiy Biologicheskiy Zhurnal (Tashkent, USSR), no. 5, Sep. - Oct. 1986 p 29-31 (For primary document see N89-14658 06-51)
Avail: NTIS HC A10/MF A01

A study was made of gas metabolism in 50 white rats exposed to high temperatures with limited motor activity. The animals were exposed to temperatures of 40 to 42 C for 2 hours each day, some in restrictive 8x15x8 cm cages which limited their motor activity. Oxygen consumption, carbon dioxide liberation, respiratory coefficient, body temperature and mass were recorded on days 1, 15, 30 and 60 of the experiments before and after exposure to the high temperatures. Exposure to heat was found to decrease oxidative processes in the organism independently of motor activity status. This decrease was still stronger in animals exposed to heat with limitation of motor activity. In both cases, the animals adapted to the conditions of the experiments. Author

**N89-14662#** Joint Publications Research Service, Arlington, VA.
**INFLUENCE OF EMOTIONAL-PAIN STRESS ON CONTRACTILE FUNCTION OF MYOCARDIUM DURING LONG-TERM HYPOKINESIA Abstract Only**
A. I. Saulya *In its* JPRS Report: Science and Technology. USSR: Life Sciences 4 Aug. 1987 p 67-68 Transl. into ENGLISH from Byulleten Eksperimentalnoy Biologii i Meditsiny (Moscow, USSR), v. 98, no. 12, Dec. 1984 p 651-653 (For primary document see N89-14658 06-51)
Avail: NTIS HC A10/MF A01

A study was made of the influence of emotional-pain stress on the contractile function of the myocardium of animals which had been maintained in long-term hypokinesia. Experiments were performed on 64 male Wistar rats following 60 days in small movement-restricting cages and exposure to 6-hr alarm neurosis. The results indicated that long-term hypokinesia caused a significant increase in the amplitude of contraction, speed of contraction and relaxation of the isolated posterior left ventricular papillary muscle, i.e., a depression in the contractile function of the cardiac muscle. The main parameters of the contractile function of the mycardium of the smaller hearts in the experimental animals which has not grown as a result of long-term hypokinesia were many times higher after stress than in the control group. The data indicate that the stress depression of the contractile function is less dangerous for animals following long-term hypokinesia than for the control animals. Long term hypokinesia may represent a chronic stress factor, causing partial adaption to stress and thus increasing the resistance of the heart to stress. thus increasing the resistance of the heart to stress. References 7 : 5 Russian, 2 Western. Author

**N89-14663#** Joint Publications Research Service, Arlington, VA.
**CORRECTION OF ACUTE HYPOXIA-INDUCED CHANGES IN BLOOD COAGULATION IN RABBITS Abstract Only**
V. V. Bakanskaya *In its* JPRS Report: Science and Technology. USSR: Life Sciences 4 Aug. 1987 p 71-72 Transl. into ENGLISH from Fiziologicheskiy Zhurnal (Kiev, USSR), v. 32, no. 2, Mar. - Apr. 1986 p 217-221 (For primary document see N89-14658 06-51)
Avail: NTIS HC A10/MF A01

Experimental therapeutic trials were conducted with rabbits to assess the utility of combined therapy with rheopolyglucin and nicotinic acid in overcoming hypercoagulation induced by acute hypoxic hypoxia. Exposing the animals to conditions simulating an altitude of 8000 m for 1 h in a pressure chamber accelerated coagulation and thrombogenesis, whereas pretreatment of the rabbits with rheopolyglucin (5 ml, i.v.) and nicotinic acid (10 mg/kg, i.m.) prevented the onset of hypercoagulation. Administration of rheopolyglucin and nicotinic acid to control rabbits was without marked effect on blood coagulation status, with the exception that the fibrinolytic system showed some activation and blood levels of free haparin were somewhat elevated. These changes were felt to underlie the therapeutic efficacy of the combined therapy in preventing hypercoagulation. Author

**N89-14664#** Joint Publications Research Service, Arlington, VA.
**FUNCTIONAL SIGNIFICANCE AND MECHANISMS OF VARIABILITY IN BARORECEPTOR REFLEX Abstract Only**
N. A. Stepochkina *In its* JPRS Report: Science and Technology. USSR: Life Sciences 4 Aug. 1987 p 72 Transl. into ENGLISH from Fiziologicheskiy Zhurnal SSSR imeni I. M. Sechenova (Leningrad, USSR), v. 72, no. 11, Nov. 1986 p 1473-1485 Original language document was announced in IAA as A87-35825 (For primary document see N89-14658 06-51)
Avail: NTIS HC A10/MF A01

Data obtained on the functional role of the aortic and carotid sinus baroreceptors and on the modulations of the baroreceptor reflex effected by the skeletal muscle contractions are analyzed. Special attention is given to the suppressive effects of muscular activity, pain stimuli, and various cortical areas on the baroreceptor reflex. The effect of respiration on the baroreflex is examined together with the role of the baroreceptor reflex in the onset of nonrespiratory sinusal arrhythmia. and demonstrates the flexibility of the cardiovascular system in meeting various physiological requirements. References 96: 12 Russian, 84 Western. Author

**N89-14665#** Joint Publications Research Service, Arlington, VA.
**SYSTEMIC HEMODYNAMIC SHIFTS IN HYPOXIA Abstract Only**
Nurmatov, A. V. Samoylenko, and B. I. Tkachenko *In its* JPRS Report: Science and Technology. USSR: Life Sciences 4 Aug. 1987 p 73 Transl. into ENGLISH from Fiziologicheskiy Zhurnal SSSR imeni I. M. Sechenova (Leningrad, USSR), v. 72, no. 11, Nov. 1986 p 1515-1522 (For primary document see N89-14658 06-51)
Avail: NTIS HC A10/MF A01

Anesthetized cats were employed in a study designed to assess the hemodynamic effects of light and moderate hypoxia. Using an O2/N2 inhalation mixture containing 14 percent O2 or 10 percent O2 resulted in hemodynamic shifts attributable largely to a decrease in peripheral vascular resistance. The venous return increased by 4.6 percent in the 14 percent O2 experiment, and by 21 percent in the 10 percent O2 studies. The increase in the cardiac output was due to the increase in the stroke volume since the heart rate decreased in both hypoxic states. The reduction in blood presure was more pronounced with moderate hypoxia than with light hypoxia, and in both cases the increase in the venous return was primarily due to the greater inflow from the superior vena cava. The latter phenomenon may reflect the fact that a greater portion of the cardiac output was directed to the cranial circulation to assure an adequate oxygen supply to the brain. Author

**N89-14666*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**BIO-REACTOR CELL CULTURE PROCESS Patent Application**
David A. Wolf, inventor (to NASA) and Ray Schwarz, inventor (to NASA) (Krug International, Houston, TX.) 30 Jun. 1988 25 p (NASA-Case-MSC-21293-1; NAS 1.71:MSC-21293-1; US-Patent-Appl-SN-213559) Avail: NTIS HC A03/MF A01 CSCL 06C

A bio-reactor system is described in which a tubular housing contains an internal circularly disposed set of blade members and a central tubular filter all mounted for rotation about a common horizontal axis and each having independent rotational support and rotational drive mechanisms. The housing, blade members and filter preferably are driven at a constant slow speed for placing a fluid culture medium with discrete microbeads and cell cultures in a discrete spatial suspension in the housing. Replacement fluid medium is symmetrically input and fluid medium is symmetrically output from the housing where the input and the output are part of a loop providing a constant or intermittent flow of fluid medium in a closed loop. NASA

**N89-14667#** Oak Ridge National Lab., Tenn.
**INTRODUCTION OF THE PROCEEDINGS OF THE TENTH SYMPOSIUM ON BIOTECHNOLOGY FOR FUELS AND CHEMICALS**
Charles D. Scott, Elias Greenbaum, and Charles E. Wyman (Midwest Research Inst., Golden, CO.) 1988 14 p Symposium held in Gatlinburg, TN, 16 May 1988
(Contracts DE-AC05-84OR-21400; DE-AC02-83CH-10093)
(DE88-016361; CONF-880521-5) Avail: NTIS HC A03/MF A01

Bioprocessing systems continue to have an important place in the fermentation industry and for environmental control technology, but new opportunities continue to appear. For example, the production of polymers or polymer precursers as well as other types of products useful in the materials industry can be produced by bioprocessing concepts. This symposium, the tenth in a series, covered the above topic as well as research and development in a variety of other areas important to the efficient and environmentally acceptable production and use of fuels and chemicals. This meeting is held as a forum for the discussion of innovative processing concepts with particular emphasis on applied research and process research in early phases of development. General sessions on thermal/chemical conversion of biomass and

bioconversion concepts were held and special sessions were held on biological processing of fossil fuels and on biological production of materials. Several discussion groups were also organized.
DOE

**N89-15017*#** National Aeronautics and Space Administration, Washington, DC.
**EXOBIOLOGY EXPERIMENT CONCEPTS FOR SPACE STATION Abstract Only**
Lynn D. Griffiths (Management and Technical Services Co., Washington, DC.) and Donald L. DeVincenzi *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 1 p Previously announced as N86-27152 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 06C

# 52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

**N89-14668#** Army Research Inst. of Environmental Medicine, Natick, MA.
**THE EFFECTS OF DIFFERENT RUN TRAINING PROGRAMS ON PLASMA RESPONSES OF BETA-ENDORPHIN, ADRENOCORTICOTROPIN AND CORTISOL TO MAXIMAL TREADMILL EXERCISE**
William J. Kraemer, Steven J. Fleck, Robin Callister, Marilyn Shealy, and Gary A. Dudley Apr. 1988 29 p Prepared in cooperation with US Olympic Committee, Colorado Springs, CO; Ohio Univ., Athens; Bionetics Corp., Kennedy Space Center, FL; and Connecticut Univ., Storrs
(AD-A197472; USARIEM-M056-88) Avail: NTIS HC A03/MF A01 CSCL 06J

The purpose of this study was to examine the effects of three different run training programs on plasma responses of beta-endorphin (beta-EP) adrenocorticotropin (ACTH) and cortisol to maximal treadmill exercise. Significant exercise-induced increases in plasma beta-EP, ACTH, cortisol and blood lactate were observed for both pre- and post-training tests. The SI group demonstrated significant post-training increases in beta-EP, ACTH, cortisol and peak 5 min post-exercise blood lactate concentrations in response to maximal exercise. No training-induced hormonal changes were observed for the E group. The C group exhibited significant post-training decreases in plasma beta-EP, ACTH and blood lactate concentrations in response to maximal exercise, while resting and post-exercise plasma cortisol measures were significantly increased in the post-training test. These data suggest that different run training programs produce differential effects on plasma beta-EP, ACTH and cortisol in response to maximal exercise, and these responses may be linked to anaerobic metabolic factors. GRA

**N89-14669#** Research Solutions, Inc., Columbus, GA.
**EFFECTS OF LOW AND HIGH OXYGEN TENSIONS AND RELATED RESPIRATORY CONDITIONS ON VISUAL PERFORMANCE: A LITERATURE REVIEW Final Report**
Frederick N. Dyer Jul. 1988 276 p
(Contract DAAL03-86-D-0001)
(AD-A198688; USAARL-88-7) Avail: NTIS HC A13/MF A01 CSCL 06D

Research was reviewed on the effects of hypoxia, hyperoxia, hypocapnia, and hypercapnia on a large number of visual and ocular processes. These included absolute visual sensitivity, dark adaptation, visual acuity, contrast sensitivity, depth perception, stereopsis, fields of peripheral and central vision, critical flicker/fusion frequency, color vision, afterimages, other entoptic phenomena, persistence of vision following ischemia, the standing potential, the electroretinogram, ganglion cell and optic-tract responses, visual evoked responses, ocular vessels, blood flow, intraocular pressure, intraocular oxygen, the pupil, accommodation, myopia, the crystalline lens, convergence, heterophoria, reading, other eye movements, and the cornea. Research was also reviewed on the potential toxic effects of hyperbaric oxygenation on vision.
GRA

**N89-14670#** Calspan Corp., Buffalo, NY.
**THE EFFECT OF PYRIDOSTIGMINE BROMINE ON INFLIGHT AIRCREW PERFORMANCE Final Report, 2 Jan. 1984 - 13 Dec. 1987**
Valerie J. Gawron, Samuel G. Schiflett, James C. Miller, John F. Ball, Timothy Slater, Faust R. Parker, Mary M. Lloyd, David J. Travale, and Ronald J. Spicuzza (Systems Research Labs., Inc., California, MD.) Jul. 1988 183 p
(Contract F33615-83-C-3603)
(AD-A198828; USAFSAM-TR-87-24) Avail: NTIS HC A09/MF A01 CSCL 15F

The effects of a chemical defense pretreatment drug, pyridostigmine bromide (PB), on inflight aircrew performance were assessed using the Total Inflight Simulation (TIFS) aircraft. The TIFS aircraft was used to supply appropriate control dynamics, handling characteristics, and cockpit instrumentation for a tactical transport simulation. Twenty-one C-130 pilots flew two familiarization flights and four data flights. During two of the data flights, PB was given to both members of the aircrew. Following are the specific conclusions: Aircrews successfully completed their assigned mission; airdrop inaccuracies and navigation errors in time and distance were not specifically related to PB; pilot flight performance and crew coordination were not affected by PB; PB and crew order significantly interacted with copilot and postflight tests; PD did not significantly affect subjective workload, fatigue, or mood; acetylcholinesterase (AChE) percent inhibition (26.8 percent) levels and plasma PB levels (17.3 nanograms/milliliter) were within expected mean peak values, but varied greatly between subjects; inflight symptoms were reported infrequently--those symptoms reported were slight to moderate in degree of severity and were not PB specific; and subjects and observers did not discriminate beyond chance between PB and placebo conditions. PB, in the dosage and regimen used for this flight test, provides a safe operational pretreatment for tactical aircrews flying a simulated airdrop mission under a chemical warfare threat. GRA

**N89-14671#** Pacific Northwest Labs., Richland, Wash.
**PROGRESS IN LUNG MODELING BY THE ICRP TASK GROUP**
A. C. James and A. Birchall Sep. 1988 34 p Presented at the Workshop on Biological Assessment of Occupational Exposure to Actinides, Versailles, France, 30 May 1988
(Contract DE-AC06-76RL-01830)
(DE88-015934; PNL-SA-15781; CONF-880514-5) Avail: NTIS HC A03/MF A01

The Task Group has reviewed the data on: (1) morphology and physiology of the human respiratory tract; (2) inspirability of aerosols and their deposition in anatomical regions as functions of respiratory parameters; (3) clearance of particles within and from the respiratory tract; and (4) absorption of different materials in the blood in humans and in animals. Evidence for evaluating the relative sensitivities of different tissues within the respiratory tract, and for defining cells at risk, has also been reviewed. On these grounds, the Task Group proposes a new model which predicts the deposition, retention and systemic uptake of materials, enabling doses absorbed by different respiratory tissues and other body organs to be evaluated. In the proposed model, clearance is described in terms of competition between the processes moving particles to the oropharynx or to lymph nodes and that of absorption into the blood. From studies with human subjects, characteristic rates and pathways are defined to represent mechanical clearance of particles from each region, which do not depend on the material. Conversely, the absorption rate is determined solely by the material: it is assumed to be the same in all parts of the respiratory tract and in other animal species. For several of the radiologically important forms of actinides, adsorption rates can be derived from animal experiments, or, in some cases, directly from human data. Otherwise, default values are used, based on the current D, W, and Y classification system. DOE

**N89-14672#** Colorado State Univ., Fort Collins. Program in Neuronal Growth and Development.
**CIRCUIT BEHAVIOR IN THE DEVELOPMENT OF NEURONAL NETWORKS Final Report, 1 Mar. 1987 - 28 Feb. 1988**
Stanley B. Kater and Barbara C. Hayes 28 Feb. 1988 4 p
(Grant AF-AFOSR-0147-87; AF Proj. 2312)
(AD-A198040; AFOSR-88-0784TR) Avail: NTIS HC A02/MF A01 CSCL 06D

The goal of this research has been to devise methods for accurately recording the activity of neuronal networks. The initial objective was to obtain multi-point recordings from neurons using extracellular electrical signals. For several reasons, this methods is now regarded with some skepticism: (1) Only neurons with very fast rising action potentials have been successfully recorded from because of the high-pass characteristics of extracellular electrodes (2) Only neuronal somata can be recorded from; (3) The primary interactions between neurons are on small neurites which are not routinely accessible by these methods; (4) Stimulation through these electrodes is quite possible, however, the efficacy of stimulation is only known when an alternative recording device is in place. Optical methods have been used with success for monitoring not just the extracellular events of neurons but also the intracellular changes in toxic activity. An extremely reliable method has been also the intracellular changes in ionic activity. An extremely reliable method has been developed, using the dye Fura 2, for analyzing calcium currents, in circuit behavior. This work allows examination of the ensemble activity of specific sets of neurons given precise classes of input in order to assess the integrative qualities of the network and the specific classes of solutions to computational problems. GRA

**N89-14673#** Loyola Univ., Chicago, IL. Hearing Inst.
**INFORMATION PROCESSING OF COMPLEX SOUNDS IN THE ANTEROVENTRAL COCHLEAR NUCLEUS Final Report, Sep. 1986 - Mar. 1988**
William P. Shofner Apr. 1988 14 p
(Grant AF-AFOSR-0326-86; AF Proj. 2313)
(AD-A198576; AFOSR-88-0850TR) Avail: NTIS HC A03/MF A01 CSCL 06D

Experiments currently in progress are designed to quantify the information in the average firing rates of cochlear nucleus neurons. Single unit responses to best frequency tone bursts are recorded, and Receiver Operating Characteristic (ROC) curves are generated from empirical spike count distributions. In order to quantify the amount of information present for an increase in discharge rate, the area under the ROC curve, P(A), is computed. For a given difference in the means of two spike count distributions regular units (such as choppers) typically give larger P(A) values than do some irregular units (such as choppers) typically give larger P(A) values than do some irregular units (primary-like or transient chopper units). These results suggest that rate information may be enhanced in certain subsystems of the cochlear nucleus. Single unit recording experiments will be carried out in the cochlear nucleus to establish whether a rate-place representation of tones and tones in noise are preserved by the chopper units (stellate cells) of the AVCN. To obtain an objective measure of how much information is present in the average discharge rate, techniques derived from Signal Detection Theory are applied to empirical spike count distributions obtained. GRA

**N89-14674#** Tours Univ. (France). Lab. de Biophysique Medicale.
**CARDIOVASCULAR SYSTEM AND SPACE ENVIRONMENT Final Report [SYSTEME CARDIOVASCULAIRE ET ENVIRONNEMENT AEROSPATIALE]**
A. Roncin 27 Sep. 1988 93 p In FRENCH
(Contract DRET-85-136)
(ETN-89-93600) Avail: NTIS HC A05/MF A01

A linear electronic scanning device with curved detector was developed in order to measure blood flux in studies concerning acceleration and microgravity conditions. The curved sensor is adjusted to a resonance of 3.5 MHz and is used both for heart or large blood vessel measurements. The onboard device allows to visualize the structures and to measure blood flow in a Doppler coded mode. The associated electronic circuits are detailed. The functional tests carried out show adequate performance. ESA

**N89-14675*** National Aeronautics and Space Administration, Washington, DC.
**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES**
Jan. 1989 75 p
(NASA-SP-7011(318); NAS 1.21:7011(318)) Avail: NTIS HC A05; NTIS standing order as PB89-912300, $10.50 domestic, $18.00 foreign CSCL 06E

This bibliography lists 223 reports, articles, and other documents introduced into the NASA scientific and technical information system in December, 1988. Author

**N89-14676*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**EYE AND HEAD MOTION DURING HEAD TURNS IN SPACEFLIGHT**
William E. Thornton, John J. Uri, Thomas P. Moore (Methodist Hospital, Indianapolis, IN.), and Sam L. Pool Jul. 1988 26 p
(NASA-TM-100466; S-580; NAS 1.15:100466) Avail: NTIS HC A03/MF A01 CSCL 06P

Eye-head motion was studied pre-, in- and postflight during single voluntary head turns. A transient increase in vestibulo-ocular reflex (VOR) gain occurred early in the flight, but later trended toward normal. This increased gain was produced by a relative increase in eye counterrotation velocity. Asymmetries in gain with right and left turns also occurred, caused by asymmetries in eye counterrotation velocities. These findings were remarkably similar to those from Soviet primate studies using gaze fixation targets, except the human study trended more rapidly toward normal. These findings differ substantially from those measuring VOR gain by head oscillation, in which no significant changes were found inflight. No visual disturbances were noted in either test condition or in normal activities. These head turn studies are the only ones to date documenting any functional change in VOR in weightlessness. Author

**N89-14677*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**STUDIES OF THE HORIZONTAL VESTIBULO-OCULAR REFLEX ON STS 7 AND 8**
William E. Thornton, John J. Uri, Thomas P. Moore (Methodist Hospital, Indianapolis, IN.), and Sam L. Pool Sep. 1988 55 p
(NASA-TM-100468; S-583; NAS 1.15:100468) Avail: NTIS HC A04/MF A01 CSCL 06P

Unpaced voluntary horizontal head oscillation was used to study the Vestibulo-Ocular Reflex (VOR) on Shuttle flights STS 7 and 8. Ten subjects performed head oscillations at 0.33 Hz + or - 30 deg amplitude under the followng conditions: VVOR (visual VOR), eyes open and fixed on a stationary target; VOR-EC, with eyes closed and fixed on the same target in imagination; and VOR-S (VOR suppression), with eyes open and fixed on a head-synchronized target. Effects of weightlessness, flight phase, and Space Motion Sickness (SMS) on head oscillation characteristics were examined. A significant increase in head oscillation frequency was noted inflight in subjects free from SMS. In subjects susceptible to SMS, frequency was reduced during their Symptomatic period. The data also suggest that the amplitude and peak velocity of head oscillation were reduced early inflight. No significant changes were noted in reflex gain or phase in any of the test conditions; however, there was a suggestion of an increase in VVOR and VOR-ES gain early inflight in asymptomatic subjects. A significant difference in VOR-S was found between SMS susceptible and non-susceptible subjects. There is no evidence that any changes in VOR characteristics contributed to SMS. Author

**N89-14660#** Joint Publications Research Service, Arlington, VA.
**HOLOGRAPHIC RECORDING OF DEFORMATION WAVES IN MUSCLE TISSUE Abstract Only**

V. S. Sinyakov *In its* JPRS Report: Science and Technology. USSR: Life Sciences 4 Aug. 1987 p 13 Transl. into ENGLISH from Byulleten Eksperimentalnoy Biologii i Meditsiny (Moscow, USSR), v. 102, no. 10, Oct. 1986 p 495-498 (For primary document see N89-14658 06-51)
Avail: NTIS HC A10/MF A01

# 53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**N89-14678#** Katholieke Universiteit, Nijmegen (Netherlands). Psychologisch Lab.
**SPACING EFFECTS IN LEARNING DESCRIBED BY THE SAM MODEL. COMPARING THREE VERSIONS OF THE SAM MODEL**
M. vanWinsum-Westra 1987 45 p
(PB88-204060; Rept-87-MA-04) Avail: NTIS HC A03/MF A01 CSCL 05I

In learning, repetition is known to improve performance, but the form of presentation (massed or spaced) is also a factor in recall. The report presents a model for spacing and repetition based on the SAM theory for memory retrieval. Three versions of the model are compared. Two are related to a verbal theory, the so-called components level theory, in which context fluctuation is used to explain spacing effects. In the third, decay of trace strength is used. GRA

**N89-14679** New South Wales Univ., Kensington (Australia). School of Psychiatry.
**AN INQUIRY INTO PANIC AND ITS DIFFERENTIATION FROM OTHER TYPES OF ANXIETY Ph.D. Thesis**
Phoebe E. Holt Mar. 1988 3 p
Avail: Issuing Activity

A review is presented and investigations reported into the distinction between panic and other types of anxiety. Agoraphobia, panic disorder and social phobia patients were compared on the symptoms they reported during periods of panic, phobic, anticipatory and generalized anxiety. Panic anxiety was found to consist of greater ratings of hyperventilatory symptoms, depersonalization and fears of impending doom than anticipatory anxiety. However, this distinction was not unique to patients with agoraphobia and panic disorder. Other comparisons were made. The results were most compatible with the idea of panic as a severe form of anxiety which occurs as a result of a particular association between somatic symptoms of anxiety and fears of impending doom. Also, the great overlap in symptoms and additional diagnoses between panic and other anxiety disorders suggest that the former group be considered as a variant of other anxiety disorders rather than a categorically distinct disorder.
Author

**N89-14680#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
**FURTHER INVESTIGATION OF CONTRAST SENSITIVITY AND VISUAL ACUITY IN PILOT DETECTION OF AIRCRAFT Final Report, Jun. 1986 - Jun. 1987**
Melvin R. ONeal and Robert E. Miller, II Jan. 1988 38 p
(AD-A198434; AAMRL-TR-88-002) Avail: NTIS HC A03/MF A01 CSCL 06D

The relationship between visual function and aircraft detection was investigated using 67 U.S.A.F. pilots. Contrast sensitivity was measured using the 2-AFC technique on the Optronix and with the Vistech chart. Visual acuity was assessed at three (3, 6, and 85 percent) chart contrasts. Pilots detected an approaching T-38 jet during 8 landings in 8 separate groups. Mean detection distance ranged from 4.77 to 6.73 miles for each group. For these partly-cloudy to cloudy test conditions, neither contrast sensitivity nor visual acuity correlated well with detection distance. There was a lack of consistency for the contrast sensitivity at any particular spatial frequency to correlate with detection. The best indicator of subjects with worse detection distances was performance on the visual acuity charts, but lower contrast sensitivity rarely identified the subjects with shorter detection distances. Neither contrast sensitivity nor visual acuity was able to identify the pilots with the best detection distances. GRA

**N89-14681#** New York Univ., New York.
**PERCEPTUAL FACTORS IN WORKLOAD: A NEUROMAGNETIC STUDY Final Technical Report, 1 Jan. 1985 - 31 Dec. 1987**
Lloyd Kaufman and Samuel J. Williamson 13 Jun. 1988 25 p
(Contract F49620-85-K-0004)
(AD-A198487; AFOSR-88-0861TR) Avail: NTIS HC A03/MF A01 CSCL 06E

This final report includes descriptions of substantive experimental studies of neural phenomena related to attention and auditory perception. It also describes efforts to enhance the superconducting instruments and other devices needed for the rapid and accurate accumulation of neuromagnetic data, and advances made in techniques for calibrating these instruments and for analyzing neuromagnetic data. The substantive experiments included a major study of the magnetic N100 phenomena and its sources and how they are affected by selective attention. Its relationship to the electrical N100 is considered, and required future research described. Also, work on the magnetic P300 phenomenon is described. This work confirmed earlier studies showing that the equivalent current dipole source is located in or near the hippocampal formation. The localization of multiple auditory sources is described. Improvements in instrumentation include the installation of a new gantry for purposes of evaluation, the design of a novel device for quantifying positions in magnetic resonance images, and the development of a graphics program for depicting a current dipole in the heads of subjects are also described. New methods for calibrating multisensor systems were developed, and the details are provided in the report. Finally, an opportunity arose during the course of this project to locate a very small metallic object accidentally embedded in the back of a human patient.
GRA

**N89-14682#** Naval Postgraduate School, Monterey, CA.
**MENTAL MODELS FOR TIME DISPLAYED TASKS M.S. Thesis**
Joyce D. Fleischman Jun. 1988 64 p
(AD-A198536) Avail: NTIS HC A04/MF A01 CSCL 23B

The study described in this thesis attempts to determine whether there is a mental model for time-ordered tasks. The results of this study may be used to assist in the design of cockpit display formats for the Intelligent Air Attack System (IAAS) in the F/A-18, A-6 or other Navy and Air Force tactical aircraft, and may be applicable to telecommunications systems as well. Basic human factors engineering concepts and the characteristics of IAAS and of the Naval Telecommunications System are described. The approach and methodology for determining whether there is a consistent mental model for time-ordered tasks is discussed, and the results of a survey are presented. Based on this survey, it was determined that mental models for time-ordered tasks are not always the same, but instead are task-dependent. Schedules are most logically presented in a calendar-like format. For telecommunications related tasks, a front-to-back format is recommended. For time-ordered events in an aircraft cockpit, a top-to-bottom display order was preferred by a majority of study participants, but aviators preferred a left-to-right presentation.
GRA

**N89-14683*#** National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.
**DEVELOPMENT AND USE OF INTERACTIVE DISPLAYS IN REAL-TIME GROUND SUPPORT RESEARCH FACILITIES**
Donald C. Rhea, Kvin R. Hammons, Jacqueline C. Malone, and Michael C. Nesel Jan. 1989 26 p Presented at the AIAA 27th Aerospace Meeting, Reno, NV, 9-12 Jan. 1989
(NASA-TM-101694; H-1529; NAS 1.15:101694) Avail: NTIS HC A03/MF A01 CSCL 05I

The NASA Western Aeronautical Test Range (WATR) is one of the world's most advanced aeronautical research flight test support facilities. A variety of advanced and often unique real-time interactive displays has been developed for use in the mission control centers (MCC) to support research flight and ground testing. These dispalys consist of applications operating on systems described as real-time interactive graphics super workstations and real-time interactive PC/AT compatible workstations. This paper reviews these two types of workstations and the specific applications operating on each display system. The applications provide examples that demonstrate overall system capability applicable for use in other ground-based real-time research/test facilities. Author

# 54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

**N89-14684*#** National Aeronautics and Space Administration, Washington, DC.
**LIVING IN SPACE**
Sheila Briskin Andrews and Audrey Kirschenbaum 1988 63 p Original doc. contains color illustrations
(EP-222) Avail: SOD HC $4.75 as 033-000-01000-1 CSCL 06K

Operation Liftoff was designed to encourage pupils in the nation's elementary schools to take a greater interest in mathematics and science. Topics addressed include: food, clothing, health, housing, communication, and working. Each unit consists of background information, a teacher printout (lesson plan), and student liftoff (activities) for levels A, B, and C. B.G.

**N89-14685#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH.
**ARTICULATED TOTAL BODY MODEL ENHANCEMENTS. VOLUME 1: MODIFICATIONS Final Report, Nov. 1983 - Dec. 1987**
Louise A. Obergefell, John T. Fleck, Ints Kaleps, and Thomas R. Gardner (Systems Research Labs., Inc., Dayton, Ohio.) Jan. 1988 87 p
(AD-A198726; AAMRL-TR-88-009) Avail: NTIS HC A05/MF A01 CSCL 20K

The Articulated Total Body (ATB) Model is used at the Armstrong Aerospace Medical Research Laboratory for human body biomechanics in various dynamic environments, especially aircraft ejection with windblast exposure. In order to improve the model's predicted results and capabilities, a number of modifications have been made. These modifications include the capability to have segment contact ellipsoids block the wind from other segments, an option to prescribe velocity dependent wind forces, a correction to prevent angular drift in the joints, improved contact force calculations for segment contact near a plane's edge, the capability to specify as input multi-axis angular displacements to describe the vehicle motion, a slip joint capability and a hyperellipsoid option. Along with these major changes, a number of minor corrections and clarifications have been included to form the ATB-IV version. The results of these modifications have been documented in three volumes of which this is Volume 1, Modifications. It contains a description of the ATB-IV modifications and the theory used to develop them. Volume 2 is an updated user's guide containing the new input description and Volume 3 is an updated programmer's guide containing a listing of all the ATB-IV subroutines. GRA

**N89-14686#** Carlow Associates, Inc., Fairfax, VA.
**HUMAN FACTORS IN THE NAVAL AIR SYSTEMS COMMAND: COMPUTER BASED TRAINING**
Thomas L. Seamster, Catherine E. Snyder, Michele Terranova, William J. Walker, and D. Todd Jones (Naval Air Systems Command, Washington, DC.) 1988 6 p Presented at the Human Factors Society Annual Meeting, Anaheim, CA, 24 Oct. 1988
(Contract DE-AC05-84OR-21400)
(DE88-015301; CONF-881058-2) Avail: NTIS HC A02/MF A01

Military standards applied to the private sector contracts have a substantial effect on the quality of Computer Based Training (CBT) systems procured for the Naval Air Systems Command. This study evaluated standards regulating the following areas in CBT development and procurement: interactive training systems, cognitive task analysis, and CBT hardware. The objective was to develop some high-level recommendations for evolving standards that will govern the next generation of CBT systems. One of the key recommendations is that there be an integration of the instructional systems development, the human factors engineering, and the software development standards. Recommendations were also made for task analysis and CBT hardware standards. DOE

**N89-14687#** Oak Ridge National Lab., Tenn. Center for Engineering Systems Advanced Research.
**MAN-ROBOT SYMBIOSIS: A FRAMEWORK FOR COOPERATIVE INTELLIGENCE AND CONTROL**
Lynne E. Parker and Francois G. Pin 1988 11 p Presented at the Advances in Intelligent Robotics Systems, Cambridge, MA, 6 Nov. 1988
(Contract DE-AC05-84OR-21400)
(DE89-000430; CONF-881116-3) Avail: NTIS HC A03/MF A01

The man-robot symbiosis concept has the fundamental objective of bridging the gap between fully human-controlled and fully autonomous systems to achieve true man-robot cooperative control and intelligence. Such a system would allow improved speed, accuracy, and efficiency of task execution, while retaining the man in the loop for innovative reasoning and decision-making. The symbiont would have capabilities for supervised and unsupervised learning, allowing an increase of expertise in a wide task domain. This paper describes a robotic system architecture facilitating the symbiotic integration of teleoperative and automated modes of task execution. The architecture reflects a unique blend of many disciplines of artificial intelligence into a working system, including job or monitoring, and machine learning. These disciplines are embodied in five major components of the symbiotic framework: the Job Planner, the Dynamic Task Allocator, the Presenter/Interpreter, the Automated Monitor, and the Learning System. DOE

**N89-14688#** Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Biodynamics and Bioengineering Div.
**ARTICULATED TOTAL BODY MODEL ENHANCEMENTS. VOLUME 3: PROGRAMMER'S GUIDE Final Report, Nov. 1983 - Dec. 1987**
Louise A. Obergefell, Ints Kaleps, Thomas R. Gardner, and John T. Fleck (J and J Technologies, Inc., Orchard Park, NY.) Feb. 1988 443 p
(AD-A197940; AAMRL-TR-88-007-Vol-3) Avail: NTIS HC A19/MF A01 CSCL 05H

The Articulated Total Body (ATB) model is used at the Armstrong Aerospace Medical Research Lab. to study human body biomechanics in various dynamic environments, especially aircraft ejection with windblast exposure. To improve the model's predicted results and capabilities, a number of modifications have been made, including the capability to have segment contact ellipsoids block the wind from other segments, an option to prescribe velocity dependent wind forces, a correction to prevent angular drift in the joints, improved contact force calculations for segment contact near a plane's edge, the capability to specify as input multi-axis angular displacements to describe the vehicle motion, a sliding joint capability and a hyperellipsoid option. Along with these major changes, a number of minor corrections and clarifications have been included to form the ATB-IV version. Volume 3, contains a complete listing of the ATB-IV program with designation of coding modifications from previous versions. GRA

**N89-14689#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

**THE EFFECT OF TRANSMISSION DESIGN ON FORCE-CONTROLLED MANIPULATOR PERFORMANCE**

William Towsend Apr. 1988 109 p

(Contracts N00014-86-K-0685; N00014-85-K-0124)

(AD-A198131; AI-TR-1054) Avail: NTIS HC A06/MF A01 CSCL 12I

The concept of manipulator force control and a corresponding emphasis on the choice of appropriate servo implementation have been developing for many years. However, the selection of appropriate mechanical hardware may ultimately be the limiting performance factor in force control. Mechanism properties, such as contact compliance, actuator-to-joint compliance, torque ripple, and highly nonlinear dry friction, affect, and often degrade, manipulator performance in force-controlled systems. This thesis describes a set of requisites for good performance, analyzes the effects of transmission-mechanism properties on force-controlled manipulators, and recommends mechanical-design strategies to improve performance. While much of the analysis applies to a broad class of transmissions, a special control-volume analysis quantifies a limit on the power efficiency of tension-element drives. A single-degree-of-freedom transmission testbed was constructed and used to confirm the predicted effect of Coulomb friction on robustness; design of a cable-driven, four-degree-of-freedom, whole-arm manipulator illustrates the recommended mechanical-design strategies. GRA

**N89-14690#** California Univ., San Diego, La Jolla. Inst. for Cognitive Science.

**COMPUTATION VIA DIRECT MANIPULATION Final Report, 1 Dec. 1984 - 29 Feb. 1988**

Donald A. Norman and Edwin L. Hutchins, Jr. 1 Aug. 1988 31 p

(Contract N00014-85-C-0133; RR04206)

(AD-A198417) Avail: NTIS HC A03/MF A01 CSCL 12I

Interfaces to complex equipment can often impose severe difficulties for the user. In part, these difficulties are caused by the abstract nature of the interaction that many modern interfaces present to the operator. A new class of interfaces, the direct manipulation interface, appears to offer improvements in ease of use and understandability because the abstraction of the normal interface is replaced with what might be called the model world metaphor, where the user can feel as if the operations are done directly upon the external environment. Research under this contract examined in detail the nature of directness in the use of computer interfaces. The research demonstrates that the concept of directness is a complex one, involving at least four different aspects of the interface, including two gulfs, one for execution and one for evaluation, and two different kinds of mappings: semantic mappings and referential distance. The experimental and theoretical work reported under this contract examines the complexities of the differences among interface styles, demonstrates the importance of visibility and sound in the performance of tasks, and presents a new, detailed analysis of the general attributes of cognitive artifacts, including an important new theoretical construct: the object-symbol. GRA

**N89-14691*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**IODINE SORPTION STUDY ON THE PROPOSED USE OF VITON A IN A SHUTTLE GALLEY WATER ACCUMULATOR**

Randall E. Gibbons, John R. Schultz (Krug International, Houston, TX.), and Richard L. Sauer Oct. 1988 19 p

(Contract NAS9-17720)

(NASA-TM-100467; S-582; NAS 1.15:100467) Avail: NTIS HC A03/MF A01 CSCL 06K

The installation of a Viton A accumulator in the Shuttle galley has been proposed to prevent overpressurization of the hot water supply system. A laboratory study has been conducted to determine if there would be any interaction between the Viton A material and the iodine used to disinfect the water. Coupons of Viton A were exposed for 24 hours to aqueous iodine solutions similar in quality to the Shuttle's potable water. Changes in the iodine residual were monitored to determine the rate of iodine sorption by the coupon. Total organic carbon (TOC) was monitored to determine the rate of desorption of organic materials from the Viton A. The same coupons were then soaked in reagent-grade water for 24 hours, and iodine was monitored to determine the rate of iodine desorption. The coupons were again exposed to iodine solutions for 24 hours and iodine and TOC were monitored. No significant change in the iodine sorption rate was detected between the first and second exposures. A triangle taste test indicated at a 1 percent confidence level that the water exposed to Viton A had a different taste which was less acceptable to the panelists. Author

**N89-14692#** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Afdeling Thermofysiologie.

**WORKING IN IMPERMEABLE CLOTHING: CRITERIA FOR MAXIMUM STRESS**

F. J. G. vandeLinde Sep. 1987 37 p In DUTCH; ENGLISH summary

(Contract A81/K/041)

(IZF-1987-24; TD-87-4831; ETN-89-93449) Avail: NTIS HC A03/MF A01

Experiments were performed in order to determine safe working times in impermeable clothing. The protective clothing of the test subject consisted of a butyl rubber decontamination garment, rubber gloves, boots, and respirator. It is found that poorly trained subjects are always limited by heart rate as are trained subjects during very heavy work. The total body heat storage criterion is only relevant for the well trained subjects, for moderately heavy workload. Core temperature criteria are never relevant since the high mean skin temperature causes the heat storage to be exceeded earlier. Dehydration is never a problem, due to the short exposure time. It is concluded that air temperature and work intensity are important variables, whereas there is no direct effect of solar load. It is beneficial to be physically fit (acclimatized, well trained). ESA

**N89-14693*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**SPACE SHUTTLE FOOD SYSTEM SUMMARY, 1981-1986**

Connie R. Stadler, Rita M. Rapp, Charles T. Bourland, and Michael F. Fohey (Lockheed Engineering and Management Services Co., Inc., Houston, TX.) Dec. 1988 335 p

(NASA-TM-100469; S-584; NAS 1.15:100469) Avail: NTIS HC A15/MF A01 CSCL 06H

All food in the Space Shuttle food system was precooked and processed so it required no refrigeration and was either ready-to-eat or could be prepared for consumption by simply adding water and/or heating. A gun-type water dispenser and a portable, suitcase-type heater were used to support this food system during the first four missions. On STS-5, new rehydratable packages were introduced along with a needle-injection water dispenser that measured the water as it was dispensed into the packages. A modular galley was developed to facilitate the meal preparation process aboard the Space Shuttle. The galley initially flew on STS-9. A personal hygiene station, a hot or cold water dispenser, a convection oven, and meal assembly areas were included in the galley. Author

**N89-14920*#** Hampton Inst., VA. Airway Science Program.

**EVALUATION OF THE PSEUDO PILOT EFFECT ON BASELINE CONTROLLER STUDY DATA Abstract Only**

Linda C. Newcomb *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 87

(For primary document see N89-14896 06-80)

Avail: NTIS HC 07/MF A01 CSCL 05H

# 55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

# 59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

**N89-14694*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**[RESEARCH CONDUCTED AT THE INSTITUTE FOR COMPUTER APPLICATIONS IN SCIENCE AND ENGINEERING IN APPLIED MATHEMATICS, NUMERICAL ANALYSIS AND COMPUTER SCIENCE] Final Semiannual Report, 1 Apr. - 30 Sep. 1988**
Nov. 1988 59 p
(Contracts NAS1-18107; NAS1-18605)
(NASA-CR-181757; NAS 1.26:181757) Avail: NTIS HC A04/MF A01 CSCL 12A

This report summarizes research conducted at the Institute for Computer Applications in Science and Engineering in applied mathematics, numerical analysis, and computer science during the period April I, 1988 through September 30, 1988. Author

# 60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

**N89-14695*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**ANALYSIS OF FDDI SYNCHRONOUS TRAFFIC DELAYS**
Marjory J. Johnson Jan. 1988 21 p
(Contract NCC2-387)
(NASA-CR-183223; RIACS-TR-88.3; NAS 1.26:183223) Avail: NTIS HC A03/MF A01 CSCL 09B

The Fiber Distributed Data Interface (FDDI) high-speed token-ring protocol provides support for two classes of service: synchronous, to support applications which require deterministic access to the channel, and asynchronous, to support applications which do not have such stringent response-time requirements. The purpose of this paper is to determine how to set ring parameters to support synchronous traffic most efficiently. Both theoretical results and results obtained from a simulation study are presented. Author

**N89-14696#** Dynamics Research Corp., Fairborn, OH.
**PROCESSOR AND DATA BUS INTERFACE ANALYSES Final Report, Apr. 1985 - Dec. 1986**
Dec. 1987 15 p
(Contract N00140-82-G-BZ99)
(AD-A198801; DRC-R-486-U; AFWAL-TR-87-1185) Avail: NTIS HC A03/MF A01 CSCL 12F

This final report provides a summary of work accomplished under the Processor and Data Bus Interface Analyses S.O.W. Task, as well as other subtasks in support of the AFWAL Avionics Laboratory for the contract period 29 April 1985 to 31 December 1986. The report, which is in five parts, outlines the objectives, achievements and conclusions of each of the following contract basic tasks and subtasks: (1) Processor and Data Bus Interface Analyses - General Support Task, 26 April 1985, (2) VHSIC 1750A Computer Fault Logging Requirements Analysis subtask, 24 February 1986, (3) Logistics Assessment Work Station (LAWS) Supportability Analysis of the VHSIC 1750A Computer subtask, 26 June 1986, (4) Operational Avionics Data for Pave Pillar Correlation subtask, 2 May 1986, and (5) Change One to the Contract S.O.W., Task No. 4, 19 June 1986. These tasks were performed for AFWAL/AAAS-3, AFWAL/CDLA and AFWAL/FIX. GRA

**N89-14697#** Los Alamos National Lab., NM.
**THE BIRTH OF THE SECOND GENERATION: THE HITACHI S-820/80**
Christopher Eoyang, Raul H. Mendez (Institute for Superconducting Research, Tokyo, Japan ), and Olaf M. Lubeck 1988 16 p Presented at the Supercomputing Conference, Orlando, FL, 14 Nov. 1988
(Contract W-7405-eng-36)
(DE88-014439; LA-UR-88-1970; CONF-881112-6) Avail: NTIS HC A03/MF A01

The performance of the new Hitachi S-820/80 supercomputer was evaluated on a set of standard FORTRAN benchmark codes that range from simple kernels to fluid dynamics applications and compared with the performance of the NEC SX-2 and CRAY X-MP/48 supercomputers. DOE

**N89-14698#** Los Alamos National Lab., NM.
**MASS STORAGE SYSTEM REFERENCE MODEL SYSTEM MANAGEMENT**
Maurice W. Collins and Tyce T. McLarty 1988 9 p Presented at the 9th IEEE Symposium on Mass Storage, Monterey, CA, 31 Oct. 1988
(Contract W-7405-eng-36)
(DE88-016325; LA-UR-88-2678; CONF-8810162-1) Avail: NTIS HC A02/MF A01

System Management is the collection of functions that are primarily concerned with the control, performance and utilization of the Mass Storage System defined by the Mass Storage System Reference Model. These functions are often very site-dependent, involve human decision making, and span multiple severs of the Mass Storage System. The functions may be implemented as standalone programs, may be integrated with the other Mass Storage System software, or may just be policy. DOE

**N89-14699#** Los Alamos National Lab., NM.
**THE JNC-16: A 16-CHANNEL DATA ACQUISITION AND ANALYSIS MODULE**
E. Ray Martin and David F. Jones Oct. 1988 17 p
(Contract W-7405-eng-36)
(DE88-017200; LA-11424-MS) Avail: NTIS HC A03/MF A01

The JNC-16 data acquisition module is a stand-alone rack-mounted electronic data processor, which was developed jointly by Los Alamos National Laboratory (advanced Nuclear Technology, Group N-2) and Jomar Systems, to fill the need for a multichannel data acquisition unit that could acquire pulse data, perform least-squares fits on the data, and download the analyzed data to the CCF and to a laser printer. This document describes in detail this electronic module and its analysis algorithms, providing an operating manual as well as a complete compendium of the functional operations available to the user. DOE

**N89-14700#** Argonne National Lab., IL. Mathematics and Computer Science Div.
**ELEFUNT TEST RESULTS UNDER FORTRAN-PLUS ON THE ACTIVE MEMORY TECHNOLOGY DAP 510-8**
W. J. Cody Sep. 1988 12 p
(Contract W-31-109-eng-38)
(DE88-017264; ANL/MCS-TM-125) Avail: NTIS HC A03/MF A01

This report discusses testing of the elementary function library supplied with FORTRAN-PLUS on the Active Memory Technology DAP 510-8 computer in the Mathematics and Computer Science Division's Advanced Computing Research Facility. Performance tests were conducted using the ELEFUNT suite of programs from

the book Software Manual for the Elementary Functions by Cody and Waite. The report includes a brief description of the computing environment, a short analysis of DAP arithmetic, and a summary and analysis of the test results. DOE

**N89-14701#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
**ADAPTABLE PULSED ANALOG-TO-DIGITAL CONVERTER**
A. N. Kuznetsov 1987 10 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE88-703778; JINR-R-13-87-774) Avail: NTIS (US Sales Only) HC A02/MF A01

In order to increase the accuracy of measuring the low amplitude pulses analog-to-digital converter (ADC) is proposed which step of quantization is adaptable for the value of input pulses. The ADC had conversion time comparable with the usual 10-bit successive type ADC, but for the pulses lower than 0.3 V its accuracy is equivalent to 14-bit ADC. The functional circuit of the ADC and its description are given as well as the results of the experimental investigations. Possibilities and peculiarities of the practical application of the ADC are discussed. DOE

**N89-14702#** Naval Postgraduate School, Monterey, CA.
**CD-ROM (COMPACT DISC READ ONLY MEMORY) LIBRARY OF THE FUTURE M.S. Thesis**
Kenneth P. Butrym and Hagop A. Avedissian Jun. 1988 132 p
(AD-A197943) Avail: NTIS HC A07/MF A01 CSCL 09E

This thesis examines the feasibility of using the compact disc-read only memory (CD-ROM) as the storage medium for the Department of Defense (DOD) construction contracting. Specifically, the DOD sponsored program, headed by the Naval Facilities Engineering Command (NAVFAC), called Construction Criteria Base (CCB) is evaluated. The program is composed of a compact disc containing government construction criteria including Army, Navy and NASA standards. The test platform used is the specification branch of NAVFAC and its Engineering Field Divisions. The CD-ROM used in conjunction with a microcomputer is compared to the standards libraries of the present which are comprised of paper, microfilm and microfiche storage media. The conclusion reached is that the use of the CD-ROM disc in the DOD construction arena is advisable. GRA

**N89-14703#** Los Alamos National Lab., NM. Computational Physics Group.
**DESIGN AND IMPLEMENTATION OF A SUPERCOMPUTER FRAME BUFFER SYSTEM**
John D. Fowler, Jr. and Michael McGowen 1988 25 p Presented at the Supercomputing Conference, Orlando, FL, 14 Nov. 1988
(Contract W-7405-eng-36)
(DE88-007834; LA-UR-88-890; CONF-881112-1) Avail: NTIS HC A03/MF A01

A 512 by 512 pixel by 8 bits per pixel frame buffer has been designed, constructed, and installed on a 48 Mbit/s I/O channel of a Cray X-MP 4/16 supercomputer. This project was undertaken to test whether such a system would be useful and, if so, how it would be used. Supporting software provides the ability to convert vector graphics description files into raster format, to show raster movies interactively, and to show vector files by real-time conversion from vector to raster formats. We have shown that real-time animations in an interactive supercomputer environment are feasible and useful with this system. DOE

# 61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

**N89-14704*#** Lockheed Missiles and Space Co., Huntsville, AL.
**DEVELOPMENT OF THE GENERAL INTERPOLANTS METHOD FOR THE CYBER 200 SERIES OF SUPERCOMPUTERS Final Report**
J. F. Stalnaker, M. A. Robinson, L. W. Spradley, S. C. Kurzius, and J. Thoenes Washington, DC Dec. 1988 203 p
(Contract NAS1-15783)
(NASA-CR-4183; NAS 1.26:4183; LMSC-HREC-TR-D867354)
Avail: NTIS HC A10/MF A01 CSCL 09B

The General Interpolants Method (GIM) is a 3-D, time-dependent, hybrid procedure for generating numerical analogs of the conservation laws. This study is directed toward the development and application of the GIM computer code for fluid dynamic research applications as implemented for the Cyber 200 series of supercomputers. An elliptic and quasi-parabolic version of the GIM code are discussed. Turbulence models, algebraic and differential equations, were added to the basic viscous code. An equilibrium reacting chemistry model and an implicit finite difference scheme are also included. Author

**N89-14705#** National Weather Service, Garden City, NY. Scientific Services Div.
**AEX: AUTOMATIC PROGRAM EXECUTION**
Harold H. Opitz Jun. 1988 70 p
(PB88-231121; NOAA-NWS-ERCP-43) Avail: NTIS HC A04/MF A01 CSCL 09B

The Automatic Program Execution (APX) package allows a site to run local applications programs on a scheduled basis, freeing users for other tasks. It consists of the programs: AEX.SV (this does the actual schedule monitoring and program execution), AEXSCHD.SV (used to create and edit the schedule file), and RBOOT.SV (used by AEX's optional auto-reboot feature). Each program is documented separately. Author

**N89-14706*#** Hawaii Univ., Honolulu. Dept. of Electrical Engineering.
**A CONCATENATED CODED MODULATION SCHEME FOR ERROR CONTROL (ADDITION 2)**
Shu Lin 25 Sep. 1988 43 p
(Grant NAG5-931)
(NASA-CR-183260; NAS 1.26:183260) Avail: NTIS HC A03/MF A01 CSCL 09B

A concatenated coded modulation scheme for error control in data communications is described. The scheme is achieved by concatenating a Reed-Solomon outer code and a bandwidth efficient block inner code for M-ary PSK modulation. Error performance of the scheme is analyzed for an AWGN channel. It is shown that extremely high reliability can be attained by using a simple M-ary PSK modulation inner code and a relatively powerful Reed-Solomon outer code. Furthermore, if an inner code of high effective rate is used, the bandwidth expansion required by the scheme due to coding will be greatly reduced. The proposed scheme is particularly effective for high-speed satellite communications for large file transfer where high reliability is required. This paper also presents a simple method for constructing block codes for M-ary PSK modulation. Some short M-ary PSK codes with good minimum squared Euclidean distance are constructed. These codes have trellis structure and hence can be decoded with a soft-decision Viterbi decoding algorithm. Furthermore, some of these codes are phase invariant under multiples of 45 deg rotation. Author

**N89-14707#** Kestrel Development Corp., Palo Alto, CA.
**SYNTHESIS OF GRAPHICAL DISPLAYS FOR TABULAR DATA Final Report, Sep. 1987 - Sep. 1988**
S. Westfold, J. Coursey, and C. Green Jan. 1988 12 p

(Contract N66001-87-C-0128)
(AD-A198979; NOSC/TD-1225) Avail: NTIS HC A03/MF A01 CSCL 14C

This paper reports on a simple theory of graphical display that generates tabular displays for data structures based on a small number of principles using visual sameness to reflect associations among the data, optimization, and well-ordering. The theory uses ideas from automatic programming including data structure reformulation and optimization. A prototype display synthesis system which embeds the generative theory as a set of transformation rules has been written. An annotated trace of the prototype as it generates a large number of displays for an example data structure demonstrates the success of the theory. Extensions of this theory are discussed. GRA

**N89-14708*#** Colorado Univ., Boulder. Cooperative Inst. for Research in Environmental Sciences.
**CLOUD CLASSIFICATION FROM SATELLITE DATA USING A FUZZY SETS ALGORITHM: A POLAR EXAMPLE Semiannual Progress Report**
J. R. Key, J. A. Maslanik, and R. G. Barry 7 Dec. 1988 39 p (Grant NAG5-898)
(NASA-CR-184568; NAS 1.26:184568) Avail: NTIS HC A03/MF A01 CSCL 09B

Where spatial boundaries between phenomena are diffuse, classification methods which construct mutually exclusive clusters seem inappropriate. The Fuzzy c-means (FCM) algorithm assigns each observation to all clusters, with membership values as a function of distance to the cluster center. The FCM algorithm is applied to AVHRR data for the purpose of classifying polar clouds and surfaces. Careful analysis of the fuzzy sets can provide information on which spectral channels are best suited to the classification of particular features, and can help determine likely areas of misclassification. General agreement in the resulting classes and cloud fraction was found between the FCM algorithm, a manual classification, and an unsupervised maximum likelihood classifier. Author

**N89-14709#** Sandia National Labs., Albuquerque, N. Mex.
**THE NC (NUMERICALLY CONTROLLED) ASSISTANT: INTERFACING KNOWLEDGE BASED MANUFACTURING TOOLS TO CAO/CAM SYSTEMS**
W. C. Burd 1988 34 p Presented at the CIM SUBWOG 39E Meeting, Cardiff, United Kingdom, 6 Oct. 1986
(Contract DE-AC04-76DP-00789)
(DE88-016742; SAND-88-2088C; CONF-8610203-2) Avail: NTIS HC A03/MF A01

A knowledge based computer program that assists programmers of numerically controlled (NC) machine tools is described. The program uses part features identified by the NC programmer and a set of expert system manufacturing rules to select cutting parameters and produce NC part programs. An expert system shell determines the NC sequence and the machining parameters. Several point-to-point NC functions are currently in production. A CAD/CAM system interface for milling and turning functions is also described. DOE

**N89-14710#** Ballistic Research Labs., Aberdeen Proving Ground, MD.
**MODERN COMPUTER-AIDED TOOLS FOR HIGH-RESOLUTION WEAPONS SYSTEM ENGINEERING Final Report**
Paul H. Deitz Feb. 1988 41 p
(AD-A197855; BRL-MR-3665) Avail: NTIS HC A03/MF A01 CSCL 12E

It is generally recognized that the potential to design and build better material is intimately connected with the capability to apply the evolving techniques of computer analysis and automation. At the outset of the cycle from concept to manufactured product, the techniques of Computer-Aided Engineering (CAE) provide the crucial capability to exercise predictive analyses of performance before systems are built. It is in the engineering phase of materiel development that optimum system designs can be generated, if properly supported via CAE. In order to fulfill its role in Army Materiel Command (AMC) as the lead laboratory in Vulnerability/Survivability, the Ballistic Research Laboratory (BRL) has developed a broad set of CAE tools that are appropriate to the examination of armored fighting vehicles, aircraft, and other military systems. The keystone of these predictive engineering models is a unified geometric modeler in which 3-D geometry is linked to material specification. All subsequent engineering analyses derive from a single geometric model. When highly detailed 3-D geometry is combined with phenomenologically based predictive models, it becomes possible to perform high-resolution estimates of weapons system performance. In this paper, an overview of such tools is presented, with examples. GRA

**N89-14711#** International Software Systems, Inc., Austin, TX.
**RADC (ROME AIR DEVELOPMENT CENTER) SYSTEM/SOFTWARE REQUIREMENTS ENGINEERING TESTBED RESEARCH AND DEVELOPMENT PROGRAM Final Technical Report, Jul. 1985 - Jul. 1986**
R. Balzer, M. Konrad, C. V. Ramamoorthy, W. Royce, W. Rzepka, S. Sherman, L. Stucki, T. Welch, and R. Yeh Jun. 1988 224 p
(Contract F30602-85-C-0129)
(AD-A197858; TR-F101/85/0129-C; RADC-TR-88-76) Avail: NTIS HC A10/MF A01 CSCL 12H

This report defines a ten-year R and D program for requirements engineering. The program will assist in the development of a Requirements Engineering Testbed of tools and methodologies for defining the requirements of planned operational systems and for examining research issues in requirements engineering. The Formal Language Track attempts to formally represent requirements and specifications in the same executable language and to develop analysis tools which provide feedback on the requirements and specifications. Such analysis includes treating the specification as a prototype and determining whether the requirements are satisfied. The Evolutionary Track is based on extending existing requirements and specifications techniques. It emphasizes prototyping with scenario generation and execution capabilities in the near/midterm, and then selectivity enhancing the associated methods, techniques and tools over the long term. In addition to this research approach, the Evolutionary Track attempts testbed integration through development of a common user interface and database for tools. In the course of its work, the panel created a generic model of the requirements engineering process, which proved to be of value in many requirements engineering discussions. The panel also characterized the background and objectives of testbed users and analyzed the possible R and D issues in the two tracks. GRA

**N89-14712#** Pittsburgh Univ., Pa. Casting Inst.
**IMPROVED FOUNDRY CASTINGS UTILIZING CAD/CAM (COMPUTER AIDED DESIGN/COMPUTER AIDED MANUFACTURE). VOLUME 1: OVERVIEW Final Technical Report, Oct. 1978 - Jun. 1985**
H. D. Brody, R. A. Stoehr, V. Srinath, W. S. Hwang, P. Wisniewski, N. Akgerman, A. Badawy, F. Fahey, S. Miller, and R. Nariman et al. 30 Jun. 1988 203 p
(Contract DAAK30-78-C-0107)
(AD-A198067; SETEC-MME-84-019-Vol-1; TACOM-TR-13121-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 11F

A software package, UPCAST, has been developed as an aid to casting engineers in designing and analyzing the manufacturing process for high integrity steel castings. The UPCAST routines use: (1) computer graphics and computer assisted computations relative to heading and gating, and (2) evaluation routines that allow 2-D and 3-D heat transfer analyses with a minimum of interaction from the user. Extensive experimental work was performed to validate the computer programs, to collect thermal properties needed for modeling steel castings in sand molds, and to predict casting soundness. Volume 1 presents an overview of the project and the UPCAST software. GRA

**N89-14713#** Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
**RANDOM ACCESS ALGORITHMS FOR MULTIUSER COMPUTER COMMUNICATION NETWORKS Ph.D. Thesis. Technical Report, 1 Sep. 1986 - 31 Aug. 1988**
P. Papantoni-Kazakos and Michael Paterakis Jul. 1988 125 p
(Contract N00014-86-K-0742; NSF ECS-85-06916)
(AD-A198090; UVA/525415/EE89/115) Avail: NTIS HC A06/MF A01 CSCL 12G

For many communication applications with time constraints (e.g., transmission of packetized voice messages), a critical performance measure is the percentage of messages which are transmitted within a given amount of time after their generation at the transmitting station. In this talk we present a random access algorithm (RAA) suitable for time-constrained applications. Performance analysis demonstrates that significant message delay improvement is attained, at the expense of minimal traffic loss. We also consider the case of noisy channels. The noise effect appears as erroneously observed channel feedback. Error sensitivity analysis shows that the proposed random access algorithm is insensitive to feedback channel errors. Window Random Access Algorithms (RAAs) are considered next. These algorithms constitute an important subclass of Multiple Access Algorithms (MAAs); they are distributive and they attain high throughput and low delays by controlling the number of simultaneously transmitting users. GRA

**N89-14714#** Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
**COMPOSING DATA AND PROCESS DESCRIPTIONS IN THE DESIGN OF SOFTWARE SYSTEMS**
Daniel Jackson May 1988 95 p
(Contract N00014-85-K-0125; NSF CCR-87-06652)
(AD-A198096; MIT/LCS/TR-419) Avail: NTIS HC A05/MF A01 CSCL 12E

Two paradigms are dominant in software development, the data paradigm and the process paradigm. Our contention is that relying exclusively on either is counter-productive. In the data paradigm, a system is specified as operations acting on states. The process paradigm focuses on sequences of events. By analyzing two specifications for the same system, one in each paradigm, we show that the prime concerns of the approaches based on the data and process paradigms are state and sequencing respectively. Without explicit data, a system cannot take advantage of representation independence, a prerequisite of modularity; without sequencing notions, the components of a system cannot be connected in an abstract fashion. Fortunately, the qualities of the two paradigms are complementary, suggesting an approach that combines the two. We present a framework in which data and process specifications can be combined to build systems. We define formally what it means for an implementation to satisfy a specification, and we show a CLU implementation of one of our examples. Finally we outline a prescriptive notion of implementation in which the specification dictates the internal structure of the implementation. GRA

**N89-14715#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
**PATTERN-DIRECTED INVOCATION WITH CHANGING EQUALITIES**
Yishai A. Feldman and Charles Rich May 1988 46 p
(Contract N00014-85-K-0124; NSF IRI-86-16644)
(AD-A198146; AI-M-1017) Avail: NTIS HC A03/MF A01 CSCL 12I

The interaction of pattern-directed invocation with equality in an automated reasoning system gives rise to a completeness problem. In such systems, a demon needs to be invoked not only when its pattern exactly matches a term in the reasoning data base, but also when it is possible to create a variant that matches. An incremental algorithm has been developed, which solves this problem without generating all possible variants of terms in the data base. The algorithm is shown to be complete for a class of demons, called transparent demons, in which there is a well-behaved logical relationship between the pattern and the body of the demon. Completeness is maintained when new demons, new terms, and new equalities are added in any order. Equalities can also be retracted via a truth maintenance system. The algorithm has been implemented as part of a reasoning system called BREAD. GRA

**N89-14716#** Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
**ROBUST ALGORITHMS FOR DETECTING A CHANGE IN A STOCHASTIC PROCESS WITH INFINITE MEMORY Technical Report, 1 Jul. 1987 - 30 Jun. 1988**
P. Papantoni-Kazakos and Rakesh K. Bansal Mar. 1988 11 p
Submitted for publication
(Grant AF-AFOSR-0224-87; AF Proj. 2304)
(AD-A198290; UVA/525682/EE88/105; AFOSR-88-0795TR)
Avail: NTIS HC A03/MF A01 CSCL 12C

The authors present and discuss a class of continuous operations on the family of discrete time stochastic processes, which serves as a guide to construct qualitatively robust operations for a given class of processes, namely the one induced by a nominal process and a substitutive contaminating process. The results are general enough to help develop any robust statistical procedure, but the authors have concentrated their attention on detection of a change from one class of processes to another (disjoint) class of processes, while both classes consist of not necessarily Markov processes and satisfy certain mixing conditions in addition to stationarity and ergodicity. Two quantitative measures of robustness, breakdown point and influence functions are also developed for few examples. GRA

**N89-14717#** Boeing Computer Services Co., Seattle, WA.
**ORDERING METHODS FOR SPARSE MATRICES AND VECTOR COMPUTERS Final Report No. 1, 1 Apr. 1987 - 31 Mar. 1988**
John G. Lewis 31 Mar. 1988 11 p
(Contract F49620-87-C-0037)
(AD-A198291; AFOSR-88-0787TR) Avail: NTIS HC A03/MF A01 CSCL 12D

Direct factorization methods for solving large sparse linear equations are used as fundamental building blocks for the numerical solution of many scientific and computational problems. It is well known that reordering the variables and equations is crucial in reducing the cost of performing direct solution techniques. The problem of finding the optimal reordering is known to be an NP-complete problem. As a result, practical reordering algorithms are heuristic, and their behavior is usually only known empirically. Different reordering heuristics have been developed in a number of different disciplines, reflecting the different types of sparse linear systems and different views of the cost of computing. This research has been concerned with furthering our understanding of how ordering heuristics and their companion numerical solution routines behave on high performance computers. The availability of such computers has led to a dramatic increase in the size and complexity of scientific computations. This is the arena in which better heuristics have the largest effect on the cost of scientific computing, but it is also an arena in which architectural constraints chosen for high speed often appear to conflict with sparsity. GRA

**N89-14718#** Illinois Univ., Urbana. Applied Computation Theory Group.
**FAULT-TOLERANT DISTRIBUTED ALGORITHMS FOR AGREEMENT AND ELECTION**
Hosame H. AbuAmara Aug. 1988 99 p
(Contract N00014-85-K-0570)
(AD-A198416; ACT-95; UILU-ENG-88-2242) Avail: NTIS HC A05/MF A01 CSCL 12G

This thesis consists of three parts. The first part characterizes completely the shared-memory requirements for achieving agreement in an asynchronous system of fail-stop processes that die undetectably. There is no agreement protocol that uses only read and write operations, even if at most one process dies. This result implies the impossibility of Byzantine agreement in

asynchronous message-passing systems. Furthermore, there is no agreement protocol that uses test-and-set operations if memory cells have only two values and two or more processes may die. In contrast, there is an agreement protocol with test-and-set operations if either memory cells have at least three values or at most one process dies. Part 2 considers the election problem on asynchronous complete networks when the processors are reliable but some of the channels may be intermittently faulty. To be consistent with the standard model of distributed algorithms in which channel delays can be arbitrary but finite, it is assumed that channel failures are undetectable. Given is an algorithm that correctly solves the problem when the channels fail before or during the execution of the algorithm. The third part presents the most efficient algorithm known of for election in synchronous square meshes. The algorithm uses 229/18n messages, runs in time units, and requires O(log(t)) bits per message. Also, we prove that any comparison algorithm on meshes requires at least 57/32n messages. GRA

**N89-14719#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Industrial Engineering and Operations Research.
**POLYGONS, STARS, AND CLUSTERS: AN INVESTIGATION OF POLYGON DISPLAYS Interim Report**
R. O. Turek and J. S. Greenstein Jan. 1988 105 p Prepared in cooperation with Clemson Univ., SC
(Contracts N66001-85-C-0254; DA Proj. F57-525)
(AD-A198430; NOSC/TD-1217) Avail: NTIS HC A06/MF A01 CSCL 23B

One technique for displaying a set of quantitative variables is to represent the set as a polygon. Such displays allow the observer to visualize complex information quickly, as a whole. Polygon displays have been employed to display information for analysis, status, or presentation. An experimental investigation was undertaken to ascertain the effect of variation in certain visual features of the display on the consistency with which people categorize information presented as polygons. Variables included background information of the display, shading, and form, Subjects performed a categorization task on two sets of data; the results are analyzed for consistency between individuals and for consistency with certain standard clustering algorithms. The effects of distinctive portions of the figures on the judgement of similarity, and of the nature of the data and of interactions of combinations of the variables used in the experiment on the consistency of clustering were noted. Implications for the design of polygon displays are discussed. GRA

**N89-14720#** University of South Florida, Tampa. Dept. of Computer Science and Engineering.
**A 3-D OBJECT RECOGNITION SYSTEM USING ASPECT GRAPHS Final Report, 15 Jul. 1987 - 14 Jul. 1988**
Kevin Bowyer, John Stewman, Louise Stark, and David Eggert 1988 8 p
(Grant AF-AFOSR-0316-87; AF Proj. 2304)
(AD-A198472; AFOSR-88-0789TR) Avail: NTIS HC A02/MF A01 CSCL 23B

This report describes a prototype 3-D object recognition system composed of three major sections: (1) an object representation module, (2) a feature extraction and matching module, and (3) a recognition control strategy module. The object representation module uses an implementation of a newly developed algorithm for the construction of perspective projection aspect graphs of convex polyhedra. The feature extraction and matching module implements a new method of using Fourier Descriptors to characterize the complete 2-D projection of an object. The recognition control strategy module uses the aspect graph object representation to control the application of a constrained optimization algorithm. The system is implemented in C on a SUN workstation, and some simple recognition experiments have been carried out to demonstrate the validity of the overall concept. The limitations of the system suggest several important avenues for future research. GRA

**N89-14721#** Army Construction Engineering Research Lab., Champaign, IL.
**DEH (DIRECTORATES OF ENGINEERING AND HOUSING) AUTOMATED GRAPHICS GUIDE: SELECTION, ACQUISITION, IMPLEMENTATION, AND MANAGEMENT Final Report**
Gene McDermott, Michael McCulley, Mary Czyszczewski, Kristine Fallon, and Douglas Youngs Jun. 1988 373 p
(AD-A198489; CERL-TR-P-88/19) Avail: NTIS HC A16/MF A01 CSCL 12E

Automated graphics technology involves the use of a computer to do drawing, mapping, charting, and illustrating tasks that previously were prepared manually using pencil and paper. Properly implemented, automated graphics systems can potentially be a huge asset to Army installation Directorates of Engineering and Housing (DEHs) in daily planning, construction, operation, and maintenance activities. An automated graphics system (AGS) offers rapid, accurate creation and manipulation of information, both graphic and textual, and facilitates quick reviews and updates of data. The U.S. Army Corps of Engineers (USACE) has demonstrated savings of 50 percent and higher as a result of applying AGS to tasks that readily benefit from automation. However, if not managed properly, automation can lose its advantage over manual processes and an organization may find that it has made a large investment for no increase in productivity or efficiency. A successful AGS is the result of careful research, planning, monitoring, and management at the DEH to provide a system best suited for the assigned tasks. Therefore, DEHs need guidance to ensure the selection of appropriate, cost-effective systems comply with Army regulations. The U.S. Army Construction Engineering Research Laboratory (USA-CERL) has conducted an investigation to develop such guidance. Based on a survey of existing DEH automated systems, USA-CERL found that each installation has unique requirements and qualifications. GRA

**N89-14722#** Naval Postgraduate School, Monterey, CA.
**A SPLIT-LEVINSON APPROACH TO AUTOREGRESSIVE MODELING M.S. Thesis**
William A. Dicken Jun. 1988 74 p
(AD-A198535) Avail: NTIS HC A04/MF A01 CSCL 12E

The classical Levinson-Durbin linear prediction formulas for real valued input sequences are examined and compared to the recently proposed split-Levinson formulas. Both the autoregressive linear predictor model and the adaptive lattice model are used to formulate the new split-Levinson algorithms. A brief introduction to the theory of symmetric polynomials is presented to form the basis of the new algorithms. Computer simulations are used to test and compare the computational accuracy of the new algorithms for AR filter coefficient estimation, parameter estimation for a moving average process, and spectral estimation of sinusoids in white noise. Research results indicate that the new algorithms reduce the number of real multiplications required for a k sub th order AR filter problem by one-half, and they are applicable to both the extended Prony method of spectral estimation of moving average parameters. GRA

**N89-14723#** California Univ., Los Angeles. Signal and Image Processing Inst.
**RESEARCH INSTRUMENTATION FOR COMPUTER VISION, IMAGE UNDERSTANDING AND OPTICAL COMPUTING Final Report, 1 Sep. 1986 - 28 Feb. 1988**
R. Chellappa 28 Feb. 1988 12 p
(Grant AF-AFOSR-0316-86; AF Proj. 2917)
(AD-A198578; AFOSR-88-0783TR) Avail: NTIS HC A03/MF A01 CSCL 12E

The following equipment was purchased SUN 3/160 workstation, 2 SUN 3/110 workstation memory boards and floating point accelerators, a Microvax II dedicated host computer, TI Explorer II AI workstation. The equipment acquired has greatly improved research productivity in the projects listed by providing up-to-date hardware and software capability. The projects are very closely related and are specifically: Image Processing and Computer Vision; Optical Implementation of Neural Networks for Computer Vision; Nonlinear Optical Information Processing; and

Optical Symbolic Computing. Common to all these areas of research is the need for: Extensive numerical simulation and modeling of devices, processors and systems; Computationally intensive transforming and analysis of algorithms performed on large arrays of image and other multidimensional data; Solution of optimization problems involving multidimensional nonlinear equations; Interframe processing between several arrays of image data; and Interactive display, manipulation and plotting of images and graphic representations of the results. GRA

**N89-14724** National Physical Lab., Teddington (England). Div. of Materials Applications.
**VAMAS SURFACE CHEMICAL ANALYSIS STANDARD DATA TRANSFER FORMAT WITH SKELETON DECODING PROGRAMS**
W. A. Dench, L. B. Hazell, and M. P. Seah Jul. 1988 63 p
(NPL-DMA(A)-164; ISSN-0143-7313; ETN-89-93574) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

A surface chemical analysis standard data transfer format was defined in a standard metalanguage, to be used by those wishing to transfer data from computer to computer via parallel interfaces or via serial interfaces over direct wire, telephone line, local area network, or other communications links. It is suitable for AES, EDX, FABMS, ISS, SIMS, SNMS, UPS, XPS, XRF, and similar analytical methods. It covers elemental maps, depth profiles, and sequences of data resulting from a variety of experiments. ESA

**N89-14725*#** Ohio State Univ., Columbus. ElectroScience Lab.
**A USER'S MANUAL FOR THE LOADED MICROSTRIP ANTENNA CODE (LMAC)**
D. P. Forrai and E. H. Newman Aug. 1988 40 p
(Grant NsG-1613)
(NASA-CR-184596; NAS 1.26:184596; ESL-719493-2) Avail: NTIS HC A03/MF A01 CSCL 09B

The use of the Loaded Microstrip Antenna Code is described. The geometry of this antenna is shown and its dimensions are described in terms of the program outputs. The READ statements for the inputs are detailed and typical values are given where applicable. The inputs of four example problems are displayed with the corresponding output of the code given in the appendices. Author

**N89-14726*#** California Univ., Los Angeles. Lab. for Flight Systems Research.
**A SURVEY OF THE STATE-OF-THE-ART AND FOCUSED RESEARCH IN RANGE SYSTEMS Final Report, 15 Jun. 1987 - 14 Jun. 1988**
Yao Kung and A. V. Balakrishnan Jun. 1988 11 p
(Grant NAG2-304)
(NASA-CR-184595; NAS 1.26:184595) Avail: NTIS HC A03/MF A01 CSCL 09B

In this one-year renewal of NASA Contract No. 2-304, basic research, development, and implementation in the areas of modern estimation algorithms and digital communication systems have been performed. In the first area, basic study on the conversion of general classes of practical signal processing algorithms into systolic array algorithms is considered, producing four publications. Also studied were the finite word length effects and convergence rates of lattice algorithms, producing two publications. In the second area of study, the use of efficient importance sampling simulation technique for the evaluation of digital communication system performances were studied, producing two publications. Author

**N89-14727#** Technische Hogeschool, Eindhoven (Netherlands).
**NUMERICAL SIMULATION OF INJECTION MOLDING: NON-ISOTHERMAL NON-NEWTONIAN FLOW OF POLYMERS IN COMPLEX GEOMETRIES Ph.D. Thesis**
Cornelius Wilhelmus Sitters 1988 115 p
(ETN-89-93348) Avail: NTIS HC A06/MF A01

Modeling problems are considered. The mathematical basis is formed by a general continuum approach, in which the solid-liquid interface is described as a discontinuity surface. The convection of heat in all directions is taken into account. A stable explicit flow front tracing technique is proposed that can be applied for every arbitrary complex configuration. Numerical simulations are compared with the experimental and numerical data from literature. The front tracing method supplies satisfactory results, which hold for the pressure and the temperature fields too. The theory presented offers the possibility to predict the behavior of polymers during the filling stage of the injection molding process with improved reliability. ESA

**N89-14728#** Rijkswaterstaat, Rijswijk (Netherlands). Dienst Informatieverwerking.
**INVESTIGATION AND SELECTION OF AN INTERACTIVE GRAPHICS AID FOR THE ANALYSIS AND DESIGN PHASE. REPORT ON THE PROJECT ISOO-03 [ONDERZOEK NAAR EN SELECTIE VAN EEN INTERACTIEF GRAFISCH HULPMIDDEL VOOR DE ANALYSE- EN ONTWERPFASE. RAPPORTAGE VAN PROJECT ISOO-03]**
Bert Schouten, Hans deJong, Ernst vanLieburg, Wim Scholten, Kees Vermeij, and Jan Wagemakers Sep. 1987 61 p In DUTCH
(AD-1987-1121; ETN-89-93442) Avail: NTIS HC A04/MF A01

Twenty interactive graphics aids that can be used during the analysis and design phases of an automation process were examined. It is found that the market is strongly changing. Most of the investigated aids aim at supporting a single method or technique. Some are more flexible in the use of methods and techniques, support more techniques and have a more powerful data dictionary. The selection of the aid Excelerator is explained, and consequences for its introduction and use are discussed. ESA

**N89-14729#** Rijkswaterstaat, The Hague (Netherlands). Dienst Informatieverwerking.
**EXPLORATION IN THE FIELD OF EXPERT SYSTEMS. REPORT ON THE PROJECT EXPERT 01 [VERKENNING OP HET GEBIED VAN EXPERTSYSTEMEN. RAPPORTAGE VAN PROJECT EXPERT 01]**
Tars deRuiter, Bert Schouten, Jan Bron, Wim Spijkervert, and Wim Vree 12 Oct. 1987 54 p In DUTCH
(AD-1987-1271; B8735340; ETN-89-93443) Avail: NTIS HC A04/MF A01

An exploratory investigation of expert systems was performed. Applications were found in any speciality using computer aids; but the expectations are often too high. The important differences between expert systems and conventional computer programs are presented. The fast evolutions in the field of expert systems are depicted. The aids required to start an expert system are outlined. It is concluded that in spite of the difficulties which have still to be overcome, expert systems are meaningful for a certain class of problems in a large number of organizations. ESA

**N89-14730#** Instituut TNO voor Werktuigkundige Constructies, Delft (Netherlands).
**DESCRIPTION OF THE NETWORK METHOD AND THE SIMULATION PACKAGE SIMULATION BASED ON NETWORKS (SIMONE) [BESCHRIJVING NETWERKMETHODE EN SIMULATIE - PAKKET SIMONE]**
D. J. Spanjer and E. deKoster May 1987 64 p In DUTCH
(Contract A86/KM/133)
(IWECO-5176814-87-1; TD-87-3579; ETN-89-93446) Avail: NTIS HC A04/MF A01

The operation and the possibilities of the simulation package SIMONE are described. This package can be used to simulate the behavior of, for example, mechanical installations, of which a network is made that is then integrated in a topology. This topology forms the basis of the calculations performed by the package. The operating instructions for the simulation package are given. The network method, its basic elements and solution method are demonstrated by an example. ESA

**N89-14731#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Regelung.
**A SOFTWARE PACKAGE FOR SEQUENTIAL QUADRATIC PROGRAMMING**
Dieter Kraft Jul. 1988 34 p
(DFVLR-FB-28-28; ISSN-0171-1342; ETN-89-93755) Avail: NTIS HC A03/MF A01; original German verion available from DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 15.50 Deutsche marks

The algorithmic principles of sequential quadratic programming (SQP) are summarized. The basic algorithms of QP (primal, primal/dual and dual approach) are given. The parameters of the software package are described. ESA

# 62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

**N89-14732#** Brown Univ., Providence, RI.
**RUNNING A LARGE MONTE CARLO PROGRAM IN A FARM OF MICROVAX-II COMPUTERS UNDER VAXELIN**
David Cutts and Jan S. Hoftun 1987 9 p Presented at the Computer Simulation Techniques in H.E. Physics, Argonne, IL, 1 Aug. 1987
(Contract DE-AC02-76ER-03130)
(DE88-012761; DOE/ER-03130/39C; CONF-8708276-1) Avail: NTIS HC A02/MF A01

This paper describes the operation of a loosely coupled farm of MicroVAX-II computers running in the VAXELN environment. Our application used the GEANT Monte Carlo package to simulate 2 TeV proton-antiproton collisions as seen by the D/null/ detector at Fermilab. The layout of the farm, the control software, and specific (small) changes to the program which were needed for operation in the farm, will be explained. DOE

**N89-14733#** Fermi National Accelerator Lab., Batavia, IL. Advanced Computer Program.
**HIGH PERFORMANCE PARALLEL COMPUTERS FOR SCIENCE: NEW DEVELOPMENTS AT THE FERMILAB ADVANCED COMPUTER PROGRAM**
T. Nash, H. Areti, R. Atac, J. Biel, A. Cook, J. Deppe, M. Edel, M. Fischler, I. Gaines, and R. Hance et al. Aug. 1988 18 p Presented at the Computational Atomic and Nuclear Physics at One Gigaflop Conference, Oak Ridge, TN, 14 Apr. 1988
(Contract DE-AC02-76CH-03000)
(DE88-016465; FNAL/C-88/97; CONF-8804125-2) Avail: NTIS HC A03

Fermilab's Advanced Computer Program (ACP) has been developing highly cost effective, yet practical, parallel computers for high energy physics since 1984. The ACP's latest developments are proceeding in two directions. A second generation ACP multiprocessor system for experiments will include RISC processors each with performance over 15 VAX MIPS. To support such high performance, the new system allows parallel I/O, parallel interprocess communication, and parallel host processes. The ACP multi-array processor, has been developed for theoretical physics. Each node is a FORTRAN or C programmable pipelined 20 MFlops (peak), 10 MByte single board computer. These are plugged into a 16 port crossbar switch crate which handles both inter and intra crate communication. The crates are connected in a hypercube. Site oriented applications like lattice gauge theory are supported by system software called CANOPY, which makes the hardware virtually transparent to users. A 256 node, 5 GFlop, system is under construction. DOE

**N89-14734#** Illinois Univ., Urbana. Coordinated Science Lab.
**PARALLEL PROCESSING TECHNIQUES FOR THE SIMULATION OF MOS VLSI CIRCUITS USING WAVEFORM RELAXATION Technical Report, Aug. 1985 - Jun. 1988**
David W. Smart Jul. 1988 148 p
(Contract N00014-84-C-0149)
(AD-A197879; UILU-ENG-88-2237; DAC-12) Avail: NTIS HC A07/MF A01 CSCL 20N

Waveform relaxation algorithms for the simulation of metal oxide semiconductors (MOS) circuits exhibit natural parallelism, arising from the intrinsic partitioning of the circuit into subcircuits which are solved separately during the iterative solution process. Investigated in this thesis is the extent to which the overall run time of a simulation can be reduced by utilizing the natural parallelism of waveform relaxation on parallel processors. GRA

**N89-14735#** Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH.
**HIGH SPEED DATA ACQUISITION SYSTEMS Report, Feb. 1982 - May 1988**
Richard D. Talmadge and Mansour Radmand (Aydin Corp., Newtown, PA.) May 1988 9 p
(AF Proj. 2401)
(AD-A198194; AFWAL-TR-88-3063) Avail: NTIS HC A02/MF A01 CSCL 09C

Air Force systems testing today requires that more and more data be acquired to a higher degree of accuracy and in fewer flights. This necessitates a new approach to dynamic data acquisition system design. In the past data acquisition organizations used either direct or FM recording techniques of one sort or another to acquire data for post test processing. This paper will outline the direction that this organization is taking to reduce the size of the installed system as well as the time and money required to maintain the system during the testing process. The system discussed provides a capability to acquire both static (DC) data and dynamic data up to 10,000 Hertz and has a dynamic range in excess of 120 dB. GRA

**N89-14736#** Naval Postgraduate School, Monterey, CA.
**EVALUATION OF WORK DISTRIBUTION ALGORITHMS AND HARDWARE TOPOLOGIES IN A MULTI-TRANSPUTER NETWORK M.S. Thesis**
William R. Cloughley Jun. 1988 97 p
(AD-A198530) Avail: NTIS HC A05/MF A01 CSCL 12F

This thesis presents the evaluation of work distribution algorithms and hardware topologies in a multi-Transputer network. The primary emphasis concerns a work distribution algorithm known as workfarm that is effective on problems that are divisible into independent work packets. All the programs and examples presented in this thesis were implemented in the OCCAM programming language, using the Transputer Development System, D700C, Beta 2.0 March 1987 compiler version. GRA

**N89-14737*#** National Aeronautics and Space Administration, Washington, DC.
**NUMBERING OF NEW ELEMENTS FOR NET REFINEMENT**
R. Pallacks Dec. 1988 6 p Transl. into ENGLISH from Numerierung der Neuen Elemente Beinetzverfeinerung (German F. R.) Z., Agnew Math. Mech. 68, no. 5, 1988 p T399-T400 Transl. into SCITRAN, Inc., Santa Barbara, CA
(Contract NASw-4307)
(NASA-TT-20435; NAS 1.77:20435) Avail: NTIS HC A02/MF A01 CSCL 09B

Discussed are new possibilities of operating net refinement methods that are open, including how determination of suitable numbering of the set is made. Author

**N89-14738#** Technische Hogeschool, Eindhoven (Netherlands).
**QUEUING NETWORK MODELS AND PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS Ph.D. Thesis**
Rudolf Johannes Wijbrands 1988 254 p Sponsored by the Stichting Informatica Onderzoek Nederland and the Netherlands Foundation for the Advancement of Pure Research
(B8811769; ETN-89-93342) Avail: NTIS HC A12/MF A01

An approximate analysis of queuing network models is presented. Heuristics are introduced to deal with various performance problems. These are evaluated by testing against simulations and by comparing the results with related approximation

methods known from literature. The description of VAX and IBM computer architecture is used to introduce the concept of a hierarchical modeling approach. The concepts are demonstrated with a small case study, the performance evaluation of a VAX computers cluster. ESA

# 63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

**N89-14739#** Vrije Univ., Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica.

**MACHINE INTELLIGENCE AND EXPLICATION**

Roel Wieringa 1987 61 p

(PB88-204078; Rept-129) Avail: NTIS HC A04/MF A01 CSCL 09B

An attempt is made to answer the question whether machines can think by conceptual analysis. The argument follows a nonideal route: it defines a machine according to concepts in computer science and systems theory and attempts to explain why that definition adequately captures informal intuitions about the nature of machine-like, mechanical processes. This leads to an explication of explicitly described processes, and a replacement of the question whether machines can think with the question whether machines can explicate. The argument is defended against possible counterarguments and compared with two wellknown criticisms of artificial intelligence. Practical and metaphysical consequences of the thesis are explored. GRA

**N89-14740#** Colorado Univ., Boulder. Center for Applied Artificial Intelligence.

**PROCEEDINGS OF THE AIR FORCE WORKSHOP ON ARTIFICIAL INTELLIGENCE APPLICATIONS FOR INTEGRATED DIAGNOSTICS**

J. Jeffrey Richardson, ed. Jul. 1987 530 p Workshop held in Boulder, CO, 29-31 Jul. 1986 Sponsored by AFSC and AFWAL (Contract N66001-83-D-0005)

(AD-A192453; AFWAL-TR-87-1101) Avail: NTIS HC A23/MF A01 CSCL 12I

These are the Proceedings of the Air Force Workshop on Artificial Intelligence (AI) Applications for Integrated Diagnostics (ID), held July 29 to 31, 1986 at the University of Colorado in Boulder. The 226 participants represented DOD, the Air Force, industry and academia. The workshop was organized as follows: introductory talks set the stage with regard to Integrated Diagnostics, three hour-long talks established the state-of-the art in AI research in diagnostics; and, some dozen shorter talks presented current applications efforts in AI/ID. Following this, three panels examined the field from the perspective of requirements, research required, and applications opportunities. A summary panel then closed the workshop. For individual titles, see N89-14741 through N89-14771.

**N89-14741#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

**GENERATING TESTS BY EXPLOITING DESIGNED BEHAVIOR**

Mark Harper Shirley *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 106-119 Sponsored in part by Digital Equipment Corp. (For primary document see N89-14740 06-63) (Contract N00014-80-C-0505)

Avail: NTIS HC A23/MF A01 CSCL 12I

One of the hardest problems in digital circuit design is test pattern generation for VLSI devices. This is difficult in part because it requires reasoning about how to control a device whose behavior can be extremely complex. Knowledge of the specific operations that the device was designed to perform can help solve this problem. The key observation is that a device's designed behavior is often far more limited than the device's potential behavior. This limitation translates into a reduction of the search necessary to achieve planning goals. We describe an implemented program based on this idea. Author

**N89-14742#** Navy Center for Applied Research in Artificial Intelligence, Washington, DC.

**THE FIS ELECTRONICS TROUBLESHOOTING SYSTEM**

Frank Pipitone *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 120-128 Submitted for publication (For primary document see N89-14740 06-63)

Avail: NTIS HC A23/MF A01 CSCL 12I

In recent years, escalating maintenance costs for electronic equipment and the increasing power of artificial intelligence methods have led to research in the application of AI to electronics trouble-shooting. FIS (for Fault Isolation System), developed in an ongoing research project sponsored at the U.S. Naval Research Laboratory, is an expert system that directs or assists a technician in diagnosing faults in a piece of electronic equipment. FIS is a more highly developed version of an earlier system. FIS has more extensive knowledge acquisition capabilities and extensive minor improvements. It is written in Franz Lisp and runs on a VAX 11/780 computer. Author

**N89-14743#** Xerox Palo Alto Research Center, Calif. Intelligent Systems Lab.

**REASONING ABOUT MULTIPLE FAULTS**

Johan deKleer and Brian C. Williams (Massachusetts Inst. of Tech., Cambridge.) *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 129-137 (For primary document see N89-14740 06-63)

Avail: NTIS HC A23/MF A01 CSCL 12I

Diagnostic tasks require determining the differences between a model of an artifact and the artifact itself. The differences between the manifested behavior of the artifact and the predicted behavior of the model guide the search for the differences between the artifact and its model. The diagnostic procedure presented in this paper is model-based, inferring the behavior of the composite device from knowledge of the structure and function of the individual components comprising the device. The system (GDE General Diagnostic Engine) has been implemented and tested on examples in the domain of troubleshooting digital circuits. This research makes several novel contributions: First, the system diagnoses failures due to multiple faults. Second, failure candidates are represented and manipulated in terms of minimal sets of violated assumptions, resulting in an efficient diagnostic procedure. Third, the diagnostic procedure is incremental, reflecting the iterative nature of diagnosis. Finally, a clear separation is drawn between diagnosis and behavior prediction, resulting in a domain (and inference procedure) independent diagnostic procedure. Author

**N89-14744#** Aeronautical Systems Div., Wright-Patterson AFB, OH.

**RECONFIGURABLE FLIGHT CONTROL: AN OPPORTUNITY FOR INTEGRATED DIAGNOSTICS** c08

E. Rachovitsky, J. W. Davison, and R. E. Guth *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 138-161 Prepared in cooperation with Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH (For primary document see N89-14740 06-63)

Avail: NTIS HC A23/MF A01 CSCL 01C

Modern flight control technology is a key for achieving flight safety and enhanced performance for future high performance military aircraft where mission complexities and multiple subsystem integration are dominant characteristics. Integrated flight/weapon control and systems have already demonstrated dramatic improvements in aircraft lethality. Now, the Flight Dynamics Laboratory (FI) examine revolutionary integration schemes involving reconfigurable flight control techniques and fault detection and isolation (FDI) methods which will dramatically enhance aircraft survivability, yield increased lethality and provide improvements in

reliability and maintainability. This paper presents an overview of key flight control R and D programs which contribute to the Flight Dynamics Laboratory's pursuit of safer, more enduring military aircraft and highlights the potential role of expert systems for diagnosis, isolation and correction of system faults. Author

**N89-14745#** Harris Corp., Syosset, NY.
**THE INTEGRATED DIAGNOSTIC SUPPORT SYSTEM**
Robert J. Frey *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 162-174 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

Diagnostic capability for the support of today's weapon systems requires a broad spectrum of trained personnel, hardware, software, and documentation. These capabilities are dispersed over a wide range of disciplines and organizations. While each group is doing its best within its own scope, little is being done to integrate these activities in a cohesive and coherent way. Often too much is expected of a single technology or maintenance level, and, instead of exploiting the complementary strengths of a range of maintenance technologies, we present the technician in the field with a bewildering array of tool and documents for a system which is difficult and costly to diagnose. The U.S. Navy's Integrated Diagnostic Support System, or IDSS, is a system concept which provides a solution to the diagnostic and maintenance deficiencies in present weapon system support. In the 1980 to 1983 time frame the Government, several professional groups (most notably the NSIA), and Harris Corporation devised the IDSS concept. On 9 April 1986, the Space and Naval Warfare Systems Command announced their selection of Harris as the winner of a competitive contract for the development and demonstration of IDSS.
Author

**N89-14746#** Gould, Inc., Rolling Meadows, IL. IC Design Automation Project.
**INCORPORATING DESIGN FOR TEST INTO AN IC DESIGN EXPERT SYSTEM**
Bob Kuhn and Alex Orailoglu *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 175-187 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

Some problems with current Integrated Circuits (IC) Computer Aided Design (CAD) systems are discussed, i.e.: (1) Increased complexity of integration necessitates system and chip planning; (2) Rapid evolution of IC technology - TTL - PMOS - NMOS - I2L - CMOS - GAAS - HEMT ---; (3) It takes 7 years from the drawing board to the field; (4) The chip lifecycle is longer than the chip design cycle; and (5) Too few are capturing the functional specifications and no one is capturing the real design goals.
Author

**N89-14747#** Southwest Research Inst., San Antonio, Tex.
**THE INTEGRATED DIAGNOSTIC MODEL: TOWARDS A SECOND GENERATION DIAGNOSTIC EXPERT SYSTEM**
Pamela K. Fink and John C. Lusth *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 188-197 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

In general, current expert system technology uses only shallow knowledge and usually employs a production rule representation. In many cases such techniques are sufficient for creating a useful system. However, in many other cases, such as in diagnosing and repairing mechanical or electrical devices, a different approach seems warranted. In such instances a deeper understanding of the problem domain is needed in order to solve problems as a human expert would. Thus, the Integrated Diagnostic Model (IDM) was developed to investigate the use of two kinds of knowledge used in diagnostic problem solving. The first is the shallow knowledge acquired through experience, while the second is a deeper knowledge based on how the device under diagnosis works.
Author

**N89-14748#** Air Force Armament Lab., Eglin AFB, FL.
**EXPERT MISSILE MAINTENANCE AID (EMMA): AN APPLICATION OF ARTIFICIAL INTELLIGENCE TECHNOLOGY TO THE MUNITION MAINTENANCE DOMAIN**
Mark A. Gersh *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 198-207 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

As weapon system complexity increases, the cost to maintain these systems rises proportionally. This complexity results in increased maintenance manpower requirements, overloading of current test equipment capabilities, and increased spare level requirements, ultimately affecting weapon systems availability. With the advent of artificial intelligence (AI) technology, specifically expert systems, these problems can begin to be controlled. The Air Force Armament Laboratory (AFATL) is working towards improving the supportability of Air Force munitions by investigating enhancements to tactical munition automatic test equipment (ATE) via expert systems. A description of this investigation follows.
Author

**N89-14749#** Boeing Military Airplane Development, Seattle, WA.
**CEPS: AN ARTIFICIAL INTELLIGENCE APPROACH TO AVIONICS MAINTENANCE**
David W. Papenhausen and Brent L. Hadley *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 208-217 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

This discussion presents CEPS, the B-1B CITS Expert Parameter System. CEPS combines expert system technology, conventional programming and a large data base to provide a system which assists in maintenance diagnostics. This approach optimizes the use of avionics design knowledge, avionics maintenance expertise, and statistical analysis of past and present failure indications to improve fault detection and isolation. Development of a prototype CEPS applied to the B-1B avionics is being performed by the Boeing Military Airplane Company under contract to the Air Force's Aeronautical Systems Division, B-1B Program Office. This paper presents a brief background of CEPS and describes the elements which compose the prototype system.
Author

**N89-14750#** University of Southern California, Redondo Beach. Behavioral Technology Labs.
**A GENERIC EXPERT DIAGNOSTICIAN**
Douglas M. Towne *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 218-237 Sponsored by Office of Naval Research, Washington, D.C. (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

In recent years Behavioral Technology Laboratories at the University of Southern California has been concerned with developing computer-based proceses for representing and understanding behaviors of complex systems. In addition, we have been concerned with the ways expert diagnosticians conduct fault isolation activities as a function of their knowledge, the constraints present in the maintenance environment, and the architecture of the system design. A key outcome of this research has been the development of a generic (device-independent) model of troubleshooting behavior which can be applied to a wide range of specific equipments (Towne, 1984, 1986). The model, termed PROFILE, generates a detailed sequence of testing actions required to isolate any fault of interest. When standard times are retrieved for each of the detailed maintenance actions, a total time to diagnose and repair is obtained. Doing this over a large sample

of representative failures produces a distribution of corrective maintenance workload implied by the system design and the maintenance conditions. Author

**N89-14751#** Lockheed Missiles and Space Co., Palo Alto, CA. Research and Development Div.
**KNOWLEDGE-BASED ANALYSIS OF TELEMETRY DATA ON THE HUBBLE SPACE TELESCOPE**
Avis Austin *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 238-248 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

A knowledge-based troubleshooting consultant called WHEELS is described, constructed using the Lockheed Expert System (LES) framework. Developed for use with the Reaction Wheel Assemblies on the Hubble Space Telescope, WHEELS aids the ground station operator in determining the cause of abnormal telemetry readings. The operator may work interactively with WHEELS, answering questions posed by the program, or the program can monitor telemetry readings automatically and begin a consultation session when any of the readings has exceeded preset limits. WHEELS calls on external procedures which calculate the thermal characteristics of key components. This information is combined with heuristic knowledge obtained from the design expert to draw conclusions about the probable cause(s) of the wayward telemetry. In addition, the user can access detailed text describing the reaction wheels and components at any time during a consultation. Permanent records in the form of equipment incident logs are kept listing each component examined and the conclusion drawn. These logs are automatically updated on exit from WHEELS. WHEELS has been developed over a four month time period with the aid of one of the designers of the space telescope. Author

**N89-14752#** Colorado Univ., Boulder. Center for Applied Artificial Intelligence.
**ARTIFICIAL INTELLIGENCE TECHNOLOGY FOR THE MAINTAINER'S ASSOCIATE**
J. Jeffrey Richardson *In its* Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 249-263 (For primary document see N89-14740 06-63)
(Contract F33615-82-C-0013)
Avail: NTIS HC A23/MF A01 CSCL 12I

The purpose of the project was to develop the technology for the Maintainer's Associate (a computer-based job aid for maintainers) based on artificial intelligence techniques, and to demonstrate a prototype system in the field. The prototype Maintainer's Associate was developed for troubleshooting the F-111 6883 intermediate-level avionics test station. The phase of the project included conceptual design, development and delivery software programming, delivery hardware prototyping, knowledge base development, field demonstration, and analysis of lessons learned. Author

**N89-14753*#** Tennessee Univ. Space Inst., Tullahoma. Knowledge Engineering Lab.
**A FLIGHT EXPERT SYSTEM (FLES) FOR ON-BOARD FAULT MONITORING AND DIAGNOSIS**
Moonis Ali, D. A. Scharnhorst, C. S. Ai, and H. J. Feber *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 264-267 (For primary document see N89-14740 06-63)
(Grant NAG1-513)
Avail: NTIS HC A23/MF A01 CSCL 09B

The increasing complexity of modern aircraft creates a need for a larger number of caution and warning devices. But more alerts require more memorization and higher workloads for the pilot and tend to induce a higher probability of errors. Therefore, an architecture for a flight expert system (FLES) is developed to assist pilots in monitoring, diagnosing and recovering from in-flight faults. A prototype of FLES has been implemented. A sensor simulation model was developed and employed to provide FLES with airplane status information during the diagnostic process. The simulator is based on the Lockheed Advanced Concept System (ACS), a future generation airplane, and on the Boeing 737. A distinction between two types of faults, maladjustments and malfunctions, has led to two approaches to fault diagnosis. These approaches are evident in two FLES subsystems: the flight phase monitor and the sensor interrupt handler. The specific problem addressed in these subsystems has been that of integrating information received from multiple sensors with domain knowledge in order to access abnormal situations during airplane flight. Malfunctions and maladjustments are handled separately, diagnosed using domain knowledge. Author

**N89-14754#** Boeing Aerospace Co., Seattle, WA.
**A MAINTENANCE AND DIAGNOSTIC INFORMATION SYSTEM**
David R. Antonelli *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 268-275 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

MDIS is a an interactive computer program that will accept the description of any piece of equipment (unit) from a person knowledgeable of that piece of equipment. MDIS elicits the information in a conversational bootstrap manner. It acts like a knowledge engineer in the area of diagnostics and maintenance, but asks the experts for a description of the unit rather than how to diagnose it. Two types of people interact with MDIS. A builder, the engineer who describes the unit to the MDIS, and the user, a novice technician who will use it to diagnose problems on the unit described. In addition to a description of any piece of equipment, MDIS asks for operating conditions, symptoms, testing, repair and preventive maintenance procedures. It never asks the builder or user how to diagnose the piece of equipment. All diagnostics are handled by the MDIS diagnostic procedure. As the system is used, it gathers information about each individual piece of equipment it diagnoses (by serial number). As it matures with use, it learns more about diagnosing a particular piece of equipment and revises its diagnostic strategy based on history. Author

**N89-14755#** Arizona Univ., Tucson. Systems and Industrial Engineering.
**EXPERT SYSTEMS TO GIVE INSTALLATION ADVICE FOR UNIX 4.2BSD AND TO HELP CONNECT A TERMINAL TO A COMPUTER**
A. Terry Bahill *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 276-291 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

Before attempting to use a computer program, you must first read its user's manual. However, this sometimes involves reading hundreds of pages of instruction. To reduce this large volume of instruction, the two tasks described in this paper were rewritten into two expert systems, i.e., two interactive textbooks were created. The original expert system was Mycin, developed to help a physician diagnose infectious blood diseases. All the knowledge put into this system already existed in books, from which the physician could have derived the proper diagnosis. However, the advantage of the expert system is that it leads the user through the knowledge base. Each question asked by the expert system is based on prior answers. Thus the user does not require answers to all possible questions, only the relevant ones. In the metaphor of the interactive textbook the user skips irrelevant chapters. By using the expert system the user is able to decrease search time and reduce the number of errors. Two of these expert systems are described: Cogito gives installation advice for bringing up the UNIX 4.2BSD operating system on a VAX computer; and DCD helps the operator connect a terminal to a computer. F.M.R.

**N89-14756#** Beazley (William G.) and Associates, Houston, TX.
**EXPERT SYSTEM RULES FROM CAD DATABASES**
William G. Beazley *In* Colorado Univ., Proceedings of the Air

Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 292-297 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

Expert systems are attractive for a variety of plant fault diagnosis applications because of their use of symbolic reasoning to narrow possibilities quickly. Programming expert systems, however, requires a manual, post hoc analysis of fault conditions. This paper presents a conceptual design for translating CAD databases in a format called Initial Graphics Exchange Specification (IGES) into diagnostic rule bases. The Process Intelligent Controller (PICON) expert system rule base is examined as a typical diagnostic rule base. Part of the rule base translates directly from IGES, the remainder is instanced by it from archived knowledge. The result is a direct interface between CAD and expert systems. Author

**N89-14757#** Automated Reasoning Corp., New York, NY.
**IN-ATE: FAULT DIAGNOSIS AS EXPERT SYSTEM GUIDED SEARCH**
Richard R. Cantone, W. Brent Lander, Michael P. Marrone, and Michael W. Gaynor *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 298-348 Submitted for publication (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

IN-ATE is an expert system architecture (or shell) specifically and exclusively designed for fault diagnosis. The key problem in fault diagnosis is deciding the best test to perform next, at each step in the troubleshooting session. The best test would minimize the average cost to diagnosis (e.g., the mean time to repair). In IN-ATE, the best test can be determined using either of two formal criteria - the gamma miniaverage heuristic search method or information theory. These two criteria both require the posterior pass/fail probability of each test. In IN-ATE, these posterior probabilities are estimated by an inner rule-based expert system. The key novel feature of IN-ATE is the ability to generate these rules automatically from CAD/CAM and reliability databases, thus providing a specialized solution to the knowledge acquisition bottleneck. Author

**N89-14758#** Lockheed Missiles and Space Co., Palo Alto, CA. Research and Development Div.
**ON-BOARD EXPERT DIAGNOSTICS FOR AN AVIONICS SUBSYSTEM**
Preston A. Cox *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 349-351 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

Fault detection and isolation in military weapons systems is an area of interest to the military. Current on-board diagnostic tools report a costly number of faults that cannot be reproduced or isolated by maintenance technicians. Maintenance testing of a subsystem that cannot be found to be faulty is costly in terms of equipment downtime and maintenance manhours. The need exists for diagnostic tools that will provide an improved fault detection and isolation capability. Expert systems technology can contribute significantly to satisfying this need. This paper describes a program to develop an Expert Integrated Diagnostician to apply advanced expert system capabilities to improving on-board fault detection and isolation in the military avionics domain. Author

**N89-14759#** Ford Aerospace and Communications Corp., Sunnyvale, CA.
**BEYOND RULES: THE NEXT GENERATION OF EXPERT SYSTEMS**
Jay C. Ferguson *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 352-362 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

This paper introduces the PARAGON Representation, Management and Manipulation system. The concepts of knowledge representation, knowledge management, and knowledge manipulation are combined in a comprehensive system for solving real-world problems requiring high levels of expertise in a real-time environment. In most applications the complexity of the problem and representation used to describe the domain knowledge tend to obscure the information from which solutions are derived. This inhibits the acquisition of domain knowledge, the capability to perform knowledge verification/validation, places severe constraints on the ability to extend and maintain a knowledge base while making generic problem solving strategies difficult to develop. Ford Aerospace has pioneered a unique hybrid system to overcome these traditional limitations. Author

**N89-14760#** McDonnell Aircraft Co., St. Louis, MO.
**AVIONICS FAULT TREE ANALYSIS AND ARTIFICIAL INTELLIGENCE FOR FUTURE AIRCRAFT MAINTENANCE**
Michael E. Harris and Thomas D. Snodgrass *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 363-374 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

The F/A-18 aircraft has demonstrated that reduced Life Cycle Costs and improved operational readiness can be designed-in without retreating from performance requirements when emphasis is properly balanced between Reliability, Maintainability and Design. The Avionics Fault Tree Analyzer (AFTA) is a suitcase size flight line tester capable of extending the F/A-18 fighter's built-in-test (BIT) fault isolation capabilities beyond the Weapon Replaceable Assembly (WRA), to the Shop Replaceable Assembly (SRA) Level. The AFTA was developed as an interim support tool for the Navy prior to attainment of total organic support capability, and as an alternate method of support to reduce Life Cycle Cost for F/A-18 foreign military sales. With the transformation of the AFTA concept from ground support equipment to avionics, a quantitative improvement in Life Cycle Costs will be obtained through the application of Artificial Intelligence (AI) techniques. AI is expected to see applications to practical problems in many disciplines; and one of which is the implementation of the military fault diagnostic system. Using AI techniques, a smart BIT is being developed which will reduce false alarms, identify intermittent failures, and improve fault isolation to the lowest possible element. Increasing density of computer memory, modularly designed avionic functions and the use of very large scale and high speed integrated devices will allow future aircraft to fly with the AFTA function. Ramifications such as eliminating the need for intermediate avionic repair facilities, increased aircraft operational readiness, decrease in aircraft recurring cost, and a reduction in spares investment are discussed. This paper will summarize the AFTA concept, Life Cycle Cost advantages, and the implementation of Artificial Intelligence in future avionic designs relative to improved reliability and maintainability. Author

**N89-14761#** Raytheon Co., Bedford, Mass.
**EXPERT SYSTEMS IN HIGHER ECHELON MAINTENANCE ACTIVITIES**
Joseph C. Hintz *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 375-383 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

Large, complex weapons systems are maintained by several echelons of troubleshooting personnel. Each echelon repairs a certain category of faults and notifies a higher echelon if unable to effect repairs. As the level of the echelon increases, the mean-time-to-repair, the training level of the maintenance personnel, the complexity of troubleshooting tools, and the difficulty in locating faults all increase. In addition, multiple faults become much more likely as maintenance-induced faults appear. An expert system that aids a higher echelon maintenance team in one subsystem (a phased array antenna) of a ground-based radar system is discussed. At this time, the expert system exceeds 33,000 lines of code (500+ rules). Lower level echelons will have repaired 95 percent of the faults by using sophisticated BITE and

computer-aided troubleshooting techniques. The faults requiring a higher echelon will require expert experienced assistance in successful troubleshooting techniques. The expert system utilized knowledge of previous maintenance activities and system level symptoms to determine the type of fault most probable. It then selects the information sources that are most useful in making a more accurate diagnosis and instructs the user in the procedures used to obtain the information. For example, diagnostic tests may be executed singly or in groups. Futhermore, the tests may be executed once in a search for hard faults or in a loop when searching for intermittents. Schematics may be used for connectivity information. Diagnostic test pseudo-code and fault mapping data may be considered to isolate the fault to plausible regions of malfunction. Discussion includes the use of meta-knowledge in the expert system to control the execution of rules, the development of an interface between the expert system and an existing graphical data base of schematics, and the expert system's ability to diagnose intermittent and multiple faults. In concludes with lessons learned and future plans. Author

**N89-14762#** Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Computer Science.

**DISTRIBUTED DIAGNOSTIC PERFORMANCE REPORTING AND ANALYSIS**

Roy A. Maxion *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 384-387 Submitted for publication (For primary document see N89-14740 06-63)

(Contracts N00014-85-K-0008; DASG60-80-C-0057)

Avail: NTIS HC A23/MF A01 CSCL 12I

This paper describes an approach to distributed performance reporting and analysis for purposes of diagnosis, maintenance, and management of a large network based computing system. The approach is to instrument relevant remote hardware and software, and to automate system monitoring data management and data analysis. A preliminary data analysis system discovers hypothesis cues useful for human or machine diagnosis of system failures and system performance degradations. The efficacy of the reporting and analysis system is demonstrated, based on an example discovered by the system while monitoring routing computers on the Carnegie Mellon University campus computing network. Author

**N89-14763#** Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH.

**THE B-1B CENTRAL INTEGRATED TEST SYSTEM EXPERT PARAMETER SYSTEM**

Gerard J. Montgomery *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 388-393 Previously announced in IAA as A87-16839 (For primary document see N89-14740 06-63)

Avail: NTIS HC A23/MF A01 CSCL 12I

The B-1B Central Integrated Test System (CITS) provides a comprehensive on aircraft diagnostic capability and records approximately 19,600 parameters. The B-1B CITS Expert Parameter System (CEPS) is an initiative to improve B1B diagnostic capabilities by applying expert system and data analysis techniques to the in-flight recorded data. The manner in which CEPS enhances B-1B on and off aircraft diagnostic capabilities and reduces false alarm, can not duplicate and re-test okay accurrences will be presented. The CEPS capabilities will be discussed and an overview of the accomplishments and status of the CEPS program will be given. This paper will illustrate the applicability of the B-1B CEPS concepts to other existing and future weapon systems. The ability to reduce future weapon system built-in test requirements through the use of on-aircraft expert systems will be discussed, along with the need for a ground based diagnostic system. Author

**N89-14764#** Magnavox Electronic Systems Co., Fort Wayne, IN. Modernization Program.

**MEND: A SELF-IMPROVING DIAGNOSTIC WITH DEEP KNOWLEDGE**

Michael L. Morgan and Michael L. Arington *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 394-400 (For primary document see N89-14740 06-63)

Avail: NTIS HC A23/MF A01 CSCL 12I

Despite advances in automated testing, fault isolation in complex systems often requires the intervention of a human troubleshooter. This is especially true when the fault falls into the cannot duplicate and retest OK categories. The troubleshooter uses experience, knowledge about the system, and knowledge about electronics in general, to form hypotheses about the fault. Further investigation of the failed system gives evidence for or against these hypotheses. This process may be partially automated using multiple, specialist knowledge sources. Knowledge sources communicate through a common database known as the blackboard. The scheduling and execution of these knowledge sources is controlled using hierarchy of planners, which also use each completed diagnosis, the system analyzes its performance to accumulate the experience and improve its future work. Author

**N89-14765#** National Security Industrial Association, Washington, DC. Integrated Diagnostics Group.

**GUIDELINES FOR PREPARATION OF DIAGNOSTIC REQUIREMENTS**

*In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 401-417 (For primary document see N89-14740 06-63)

Avail: NTIS HC A23/MF A01 CSCL 12I

The Office of the Assistant Secretary of Defense requested the National Security Industrial Association's Integrated Diagnostics Group to embark on a three-step program aimed at the implementation of integrated diagnostics. The first step called for review of recent Request for Proposal (RFP) packages to formulate recommendations for change in the way requirements for diagnostics are written. The second step included development of guidelines and revisions to current instructions. The third step consisted of defining a phased approach for resolution of technical problems leading to the automation of the diagnostic design process. This report addresses the first step. Initially, OSD requested a brief review of some recent Weapon System RFPs and preparation of sample Statements of Work which address integrated diagnostics and which can be included in RFPs. It was requested that these sample Statements of Work be limited to five or six pages, maximum, and that these could be initially applied within three months, followed by a more detailed look at the acquisition process. Author

**N89-14766#** Combustion Engineering, Inc., Windsor, CT. Nuclear Services Research and Development.

**GDS: AN INTELLIGENT DIAGNOSTIC SOFTWARE SHELL**

Carl H. Neuschaefer and Peter Rzasa *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 418-424 (For primary document see N89-14740 06-63)

Avail: NTIS HC A23/MF A01 CSCL 12I

A generic software shell for performing realtime diagnosis is described. This LISP based software shell provides a skeletal framework that can be applied to process, plant or system diagnosis problem domains. The software shell performs a two level diagnosis, provides an intelligent request for information user interface and provides automated recovery alternatives and recommendations. The two level diagnosis is based on a top level rule based critical function approach and a detailed physical diagnosis model based root cause assessment. The power of a combined production rule based and logic model based approach and the real-time aspects are emphasized. Author

**N89-14767#** FMC Corp., Santa Clara, CA. Central Engineering Labs.

**A GENERIC ARCHITECTURE FOR KNOWLEDGE-BASED EQUIPMENT FAULT DIAGNOSIS**

Cynthia K. Pickering, Keith T. Wescourt, and Christopher A.

Powell *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 425-430 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

Currently available software technology for building knowledge-based systems provides no mechanisms to support similar design and implementation for closely-related applications. In this paper, we consider how an appropriate organization of knowledge in expert systems can support the reuse of knowledge base content and thus accommodate families of applications. We describe the design and software implementation of a knowledge base organization for fault diagnosis application involving a family of complex electrical-mechanical-hydraulic equipment. Author

**N89-14768#** FMC Corp., Santa Clara, CA. Central Engineering Labs.
**SYSTEM INTEGRATION OF KNOWLEDGE-BASED MAINTENANCE AIDS**
Christopher A. Powell, Cynthia K. Pickering, and Keith T. Wescourt *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 440-451 Submitted for publication (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

There are many examples of knowledge-based fault diagnosis advisors for corrective maintenance of complex equipment. However, such advisors are only part of an overall maintenance solution. To be used effectively, diagnostic advisors must be integrated with other existing and forthcoming systems, such as Automated Test Equipment and maintenance databases. Successful fielding of knowledge-based systems requires consideration of integration issues throughout the design process. Author

**N89-14769#** Colorado Univ., Boulder.
**ARTIFICIAL INTELLIGENCE IN TEST PROGRAM DEVELOPMENT**
J. Jeffrey Richardson and George H. Barthelenghi (Giordano Associates, Inc., Sparta, NJ.) *In its* Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 453-467 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

This paper reviews artificial intelligence research pertinent to the fault isolation requirement of test program development for factory and field test. Diagnosis as classification problem-solving is defined and described. The diagnostic problem solving AI literature is divided into two major groups. Specification-based diagnosis solves diagnostic problems by reasoning from a device model, enabling reasoning directly from a deep theory consisting of information about intended structure and behavior. Symptom-based diagnosis solves diagnostic problems by manipulating a set of associations between symptoms and faults where principled rationale for association is inaccessible or unknown. Specification-based diagnosis is the approach of choice for test program development for fault isolation during system design and development, while symptom-based diagnosis is appropriate for maintaining test programs for fielded systems. Therefore, a hybrid architecture is desirable in which the two approaches can be integrated. Extensive references to the literature are provided. Author

**N89-14770*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
**SENSOR-BASED DIAGNOSIS USING KNOWLEDGE OF STRUCTURE AND FUNCTION**
Ethan A. Scarl (Mitre Corp., Bedford, MA.), John R. Jamieson, and Carl I. Delaune *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 468-484 Submitted for publication (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 09B

A system for fault detection and isolation called LES, developed at the Kennedy Space Center for the Space Shuttle's Launch Processing System, is a well-developed diagnostic system that is simultaneously model-based and sensor-based. This experiment has led to a surprising result: the failure of a sensor can not only be handled in precisely the same way as the failure of any other object, but may present an especially easy case. Classical rule-based diagnostic systems need to find out whether or not their sensors are telling them the truth before they can safely draw inferences from them. By contrast, while LES does treat sensors as a special case, it does so only because there may exist a short cut that allows them to be handled more simply than other objects. LES uses both structural and functional knowledge, and has found cases in which the structural knowledge can be economically replaced by the judicious use of functional relationships; LES' functional relationships are stored in exactly one place, so they must be inverted to determine hypothetical values for possibly faulty objects. The inversion process has been extended to include conditional functions not normally considered to have inverses. Author

**N89-14771#** Rockwell International Corp., Thousand Oaks, Calif. Science Center.
**EXPERT SYSTEM ON A CHIP: AN ENGINE FOR REAL-TIME APPROXIMATE REASONING**
Masaki Togai and Hiroyuki Watanabe (Bell Telephone Labs., Inc., Holmdel, NJ.) *In* Colorado Univ., Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics Jul. 1987 p 485-493 (For primary document see N89-14740 06-63)
Avail: NTIS HC A23/MF A01 CSCL 12I

The role of inferencing with uncertainty is becoming more important in rule-based expert systems (ES), since knowledge given by a human expert is often uncertain or imprecise. We have succeeded in designing a VLSI chip which can perform an entire inference process based on fuzzy logic. The design of the VLSI fuzzy inference engine emphasizes simplicity, extensibility, and efficiency (operational speed and layout area). It is fabricated in 2.5 micron CMOS technology. The inference engine consists of three major components: a rule set memory, an inference processor, and a controller. In this implementation, a rule set memory is realized by a read only memory (ROM). The controller consists of two counters. In the inference processor, one data path is laid out for each rule. The number of the inference rule can be increased adding more data paths to the inference processor. All rules are executed in parallel, but each rule is processed serially. The logical structure of fuzzy inference proposed in the current paper maps nicely onto the VLSI structure. A two-phase nonoverlapping clocking scheme is used. Timing tests indicate that the inference engine can operate at approximately 20.8 MHz. This translates to an execution speed of approximately 80,000 Fuzzy Logical Inferences Per Second (FLIPS), and indicates that the inference engine is suitable for a demanding real-time application. The potential applications include decision-making in the area of command and control for intelligent robot systems, process control, missile and aircraft guidance, and other high performance machines. Author

**N89-14772#** Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
**OPTICAL INFERENCE MACHINES Interim Report, 15 Aug. 1986 - 14 Aug. 1987**
Cardinal Warde 27 Jun. 1988 28 p
(Grant AF-AFOSR-0301-86)
(AD-A197880) Avail: NTIS HC A03/MF A01 CSCL 12I

We have been investigating an optical inference machine based on mapped-template architecture. During this first year, two subsystems for use in our study of this machine were developed: (1) a portable electron-beam-addressed microchannel spatial light modulator (e-beam MSLM) and (2) a computerized control system for the architecture. This report describes the mapped-template inference machine and the development of its components in the context of the overall system architecture. GRA

**N89-14773#** Ballistic Research Labs., Aberdeen Proving Ground, MD.
**AN EVALUATION OF FIVE PC-BASED EXPERT SYSTEM SHELLS Final Report, Sep. 1986 - Mar. 1987**
Frederick J. Shaw and Robert A. Fifer Mar. 1988 41 p
(AD-A197915; BRL-TR-2908) Avail: NTIS HC A03/MF A01 CSCL 12E

Five expert system shells (three example-based and two rule-based) were evaluated for this project. These shells offer an advantage in that they can help reveal interrelationships that are not readily apparent, since they draw their own conclusions from the data. However example-based systems are more rigid and inflexible which makes them more difficult to work with. Rule-based systems are more difficult to learn to use, since they involve entering if-then-else rules. However (especially in the case of INSIGHT 2+) they offer more flexibility and freedom, since the knowledge engineer or programmer has control over the development and use of the rules. Of the five shells evaluated, INSIGHT 2+ offers the best features for the development of the propellant formulation expert systems. GRA

**N89-14774#** Syracuse Univ., N. Y.
**NORTHEAST ARTIFICIAL INTELLIGENCE CONSORTIUM ANNUAL REPORT 1986. VOLUME 3: DISTRIBUTED ARTIFICIAL INTELLIGENCE FOR COMMUNICATION NETWORK MANAGEMENT Interim Technical Report, Jan. Dec. 1986**
Robert A. Meyer and Susan E. Conry Jun. 1988 50 p
(Contract F30602-85-C-0008)
(AD-A197957; RADC-TR-88-11-Vol-3) Avail: NTIS HC A03/MF A01 CSCL 12I

The Northeast Consortium conducts pertinent research in artificial intelligence and performs activities ancillary to this research. This report describes process that has been made in the second year of the existence of the consortium on the technical research tasks undertaken at the member universities. The topics covered in general are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance and explanation system. The specific topic for this volume is the use of knowledge-based systems for communications network management and control via an architecture for a diversely distributed multi-agent system. GRA

**N89-14775#** Search Technology, Inc., Norcross, Ga.
**DEVELOPMENT AND DEMONSTRATION OF MICROCOMPUTER INTELLIGENCE FOR TECHNICAL TRAINING (MITT) Final Technical Paper, Jul. 1987 - Jan. 1988**
William B. Johnson, Ruston M. Hunt, Phillip C. Duncan, and Jeffrey E. Norton Aug. 1988 43 p
(Contract F41689-86-D-0052)
(AD-A197971; AFHRL-TP-88-8) Avail: NTIS HC A03/MF A01 CSCL 12I

The Microcomputer Intelligence for Technical Training research described here is founded upon a proven intelligent diagnostic training simulation to construct enhanced models of the student, instructor, and expert in a training environment. An off-the-shelf microcomputer was used to deliver an operational intelligent tutoring system (ITS) with 180 days of project start. The demonstration ITS was developed in cooperation with Air Force and NASA personnel at the Lyndon B. Johnson Space Center in Houston, TX. The space shuttle fuel cell was the technical domain for this first application. Initial trial use by astronauts, flight controllers, and technical training personnel indicates that the approach is technically feasible and has instructional value for space training applications. GRA

# 64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

**N89-14776#** National Center for Earthquake Engineering Research, Buffalo, NY.
**FINITE ELEMENT FORMULATION FOR NONLINEAR VISCOPLASTIC MATERIAL USING A Q-MODEL**
Osei K. Gyebi and Gautam Dasgupta (Columbia Univ., New York, NY.) 2 Nov. 1987 162 p
(Grants NSF ECE-86-07591; NSF ECE-85-15249)
(PB88-213764; NCEER-87-0005) Avail: NTIS HC A08/MF A01 CSCL 12A

A direct comparison of the rheological behavior of a mass supported by a complex spring and a mass supported by a spring dashpot arrangement provides a means of establishing a relationship between material damping in the frequency domain and the frequency dependent Q (omega). For the special case where Q is constant over a given frequency range, the expansion of Q to the (-1) power, i.e., the measure of energy dissipation per cycle, into a Laurent series yields a set of damping coefficients whose values are determined by minimizing the mean square error of the series over the prescribed frequency range. The resulting damping expression is used in conjunction with an elastoplastic constitutive matrix in finite element discretization to produce a viscoplastic model suitable for a direct step by step time integration. The proposed model is very convenient for use in finite element discretization for the analyses of earthquake, blast, shock, and other soil-structure interaction problems involving cyclic loading. GRA

**N89-14777#** Vrije Univ., Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica.
**CONNECTED PART OF THE COVARIANT TATE p-DIVISIBLE GROUP AND THE ZETA-FUNCTION OF THE FAMILY OF HYPERELLIPTIC CURVES y SUP 2 = 1 + MU(CHI SUP N) MODULO VARIOUS PRIMES**
Bert E. J. Ditters and Simen J. Hoving Dec. 1987 35 p
(PB88-226659) Avail: NTIS HC A03/MF A01 CSCL 12A

The authors determine for mu epsilon W (k), k an arbitrary finite field of characteristics p greater than 2 with p sup a elements, the explicit action of the sigma-linear Frobenius (F sub p) on the connected component of the covariant Tate module of the Jacobian variety for the family of curves, defined by y squared = 1 + mu(chi sup N). From this, various objects, such as the decomposition into isogeny factors and the characteristic polynomial of the linear Frobenius pi= (F sub p, sup a) can be studied. GRA

**N89-14778#** Massachusetts Inst. of Tech., Cambridge. Sea Grant Coll. Program.
**COMPUTATION OF ALGEBRAIC POLYNOMIAL PARAMETRIC SURFACE INTERSECTIONS**
N. M. Patrikalakis and P. V. Prakash Dec. 1987 114 p
(Grant NA86AA-D-SG089)
(PB88-208277; MITSG-87-19; R/T-16) Avail: NTIS HC A06/MF A01 CSCL 12A

Presented are the basic elements of a new algorithm to trace a planar algebraic curve f(u,v)=0 within a rectangular parallelogram arising in the context of automatic interrogation of intersections of algebraic surfaces and piecewise continuous rational polynomial parametric surface patches. The method combines the advantageous features of analytic representation of the governing equation in the Bernstein basis with adaptive subdivision techniques and the a priori computation of turning and singular points to provide the basis for a reliable and efficient solution procedure. Representative results from the application of the method in tracing well known algebraic curves and in computing intersections of typical algebraic and rational polynomial surfaces are also presented. GRA

**N89-14779#** National Academy of Sciences - National Research Council, Washington, DC. Commission on Physical Sciences, Mathematics and Resources.
**MATHEMATICAL SCIENCES: SOME RESEARCH TRENDS**
1988 133 p
(PB88-232798) Avail: NTIS HC A07/MF A01 CSCL 12A

A report on Mathematical Science contains the following: Research trends (Applied mathematics, Core mathematics, Statistical sciences); Vignettes (Interacting particle systems; Bootstrap and other resampling methods, Tree-structured methods for classification, Adaptive methods for partial differential equations, Problems and progress on homogenization, Arithmetic on curves, Soliton theory, Field theory and mathematics). GRA

**N89-14780#** Los Alamos National Lab., NM. Theoretical Div.
**A DIRECT ITERATIVE-VARIATIONAL METHOD FOR SOLVING LARGE SETS OF LINEAR ALGEBRAIC EQUATIONS**
B. I. Schneider and L. A. Collins 1988 20 p Presented at the Workshop on Practical Iterative Methods for Large Scale Computations, Minneapolis, MN, 23 Oct. 1988
(Contract W-7405-eng-36)
(DE88-016149; LA-UR-88-2823; CONF-8810119-3) Avail: NTIS HC A03/MF A01

We have developed a direct iterative-variational technique for solving large systems of linear equations: Ax = b, where N is the order of the matrix A and the length of the vectors x and b. The method, which has analogs in the conjugate gradient and Lanczos schemes as well as the direct configuration interaction procedures of quantum chemistry, involves the construction of an orthonormal basis from successive applications of the general linear algebraic (LA) matrix, A, to an initial guess for the solution vector. The solution vector is expanded in this basis, and the coefficients are determined from a variational prescription. For n iterations, the number of operations to solve the LA equations is of the order N sup 2n. Since the basis is orthonormal, the procedure is guaranteed to converge within N iterations, provided that the basis vectors remain linearly independent. In practice, the convergence is much more rapid (n much smaller than N). Another advantage of the method is that the whole matrix A need not be stored. In the more general case of multiple right-hand-sides (x and b, matrices), the method can be applied simultaneously to all of the solutions, thus saving many redundant operations that would arise from treating each column of x independently. We have applied the technique to the solution of LA systems that arise from converting radial coupled integrodifferential equations to an integral representation on a discrete quadrature, in particular, to a variety of problems for electron-atom and -molecule collisions. DOE

**N89-14781#** Illinois Univ., Urbana. Dept. of Computer Science.
**APPROXIMATION METHODS FOR THE CONSISTENT INITIALIZATION OF DIFFERENTIAL-ALGEBRAIC EQUATIONS**
Benedict J. Leimkuhler Aug. 1988 94 p
(Contract DE-FG02-87ER-25026)
(DE88-017316; DOE/ER-25026/24; UIUCDCS-R-88-1450; UILU-ENG-88-1755) Avail: NTIS HC A06/MF A01

The algebraic constraints in a system of differential-algebraic equations (DAEs) impose a consistency requirement on the initial values that can be difficult to satisfy. In this thesis the consistency requirement is characterized by a system of equations. An approximation method is introduced for these equations, and the numerical solution of the resulting system is analyzed for certain important classes of DAEs. Finally, some numerical experiments are described. DOE

**N89-14782#** Japan Atomic Energy Research Inst., Tokyo. Dept. of Reactor Engineering.
**A GENERAL EXPRESSION OF JACOBIAN MATRIX AND ITS SIMPLIFIED COMPUTATION METHOD: RELATIONSHIPS BETWEEN THE VELOCITIES OF MANIPULATOR HAND AND JOINTS**
Shinobu Sasaki May 1988 44 p In JAPANESE; ENGLISH summary
(DE88-754808; JAERI-M-88-087) Avail: NTIS (US Sales Only) HC A03/MF A01

In this paper, the computation method of the Jacobian matrix, which is frequently utilized in the manipulator control, is theoretically derived. In addition, the combined use of a general formulation for manipulator kinematics reported in the preceding paper leads to an automatic generation by computer of the Jacobian matrix for any type of manipulator, with the consequence that we are set free from the conventional cumbersome hand precalculation necessary for obtaining the Jacobian elements. As such, the present simple approach based on the recursive expression is proven to be of sufficiently practical use for the requirement of high-speed computation. DOE

**N89-14783#** Illinois Univ., Urbana. Dept. of Computer Science.
**COMPUTATIONAL METHODS AND SOFTWARE FOR DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS Annual Report**
C. W. Gear and R. D. Skeel Jul. 1988 10 p
(Contract DE-FG02-87ER-25026)
(DE89-000025; DOE/ER-25026/T2) Avail: NTIS HC A02/MF A01

This paper discusses the following topics: parallel and waveform methods for ordinary differential equations, differential-algebraic equations, and multilevel methods. DOE

**N89-14784#** Department of Energy, Washington, DC.
**SUMMARIES OF THE FY88 APPLIED MATHEMATICAL SCIENCES RESEARCH PROGRAM**
Sep. 1988 71 p
(DE89-000242; DOE/ER-0386) Avail: NTIS HC A04/MF A01

This report is a compilation of summaries of the individual research projects that constitute the Applied Mathematical Sciences research subprogram managed by the Director, Scientific Computing Staff, Office of the Director of Energy Research, Department of Energy. The general topics of the research projects are: analytical and numerical methods; Information analysis techniques; advanced computing concepts, energy science advanced computation; and capital equipment. DOE

**N89-14785#** Oak Ridge National Lab., Tenn.
**GENERATION OF AN ORDERED SIMPLE RANDOM SAMPLE WITHOUT REPLACEMENT USING ONE RANDOM NUMBER**
Y. H. Etheridge and T. Wright Aug. 1988 12 p
(Contract DE-AC05-84OR-21400)
(DE89-001341; ORNL/TM-10868) Avail: NTIS HC A03/MF A01

Examples are presented for a method to identify the n units to be included in a simple random sample (SRS) for selection from a finite universe of N(greater than n) distinct and indentifiable units. The method calls for the generation of only one random number to select a SRS of n units without having to list all binomial coefficients, possible samples - practically all other methods require the generation of between n and N random numbers. Wright has given a slightly faster and generalized algorithm and demonstrated that the generalized algorithm to generate a SRS has a natural relation with Pascal's Triangle. The slight improvement in speed is a direct result of the establishment of a link with Pascal's Triangle. A program that executes the generalized algorithm as described by Wright is discussed. DOE

**N89-14786#** Lawrence Livermore National Lab., CA.
**PARALLEL HETEROGENEOUS MESH REFINEMENT FOR ADVECTIVE-DIFFUSIVE EQUATIONS**
A. Louise Perkins and G. Rodrigue 22 Jun. 1988 12 p Presented at the 11th International Conference on Numerical Methods in Fluid Dynamics, Williamsburg, VA, 27 Jun. 1988
(Contract W-7405-eng-48)
(DE88-017026; UCRL-98991; CONF-8806125-4) Avail: NTIS HC A03/MF A01

Advective-diffusive equations combine phenomena that occur at different time scales. The particle-advective diffusive equations are first advanced on a coarse mesh subject to the hyperbolic

stability condition. Significant parabolic regions are identified with a parabolic threshold criteria, and the coarse mesh is dynamically decomposed and refined. An Euler-Lagrange method advances these refined subdomains independently, allowing coarse grain parallel scheduling. Our applications are drawn from fluid dynamics; here we use the two-dimensional Burgers equation. DOE

**N89-14787#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
**ANALOGS OF CLIFFORD ALGEBRA FOR FORMS ABOVE QUADRATIC AND THEIR MATRIX REALIZATION**
R. M. Yamaleev 1987 8 p In RUSSIAN; ENGLISH summary
(DE88-703748; JINR-R-5-87-766) Avail: NTIS (US Sales Only)
HC A02/MF A01

Matrix representations for generators of algebra with multilinear anticommutation relations inducible by N(M)-form are found. An algorithm for the construction of a matrix generator is proposed and a theorem is proved concerning the correspondence of the algorithm and the roles of multilinear anticommutation relations. The matrices obtained have characteristics analogous to the properties of basic matrices of Clifford algebra. DOE

**N89-14788#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
**FINITE-DIFFERENCE METHODS FOR SOLUTION OF THE MANY-DIMENSIONAL NONLINEAR SCHROEDINGER EQUATION**
E. Yu. Panova and A. B. Shvachka 1987 10 p In RUSSIAN; ENGLISH summary
(DE88-703772; JINR-R-11-87-721) Avail: NTIS (US Sales Only)
HC A02/MF A01

The brief review of the finite-difference methods used to solve the many-dimensional nonlinear Schroedinger equation is presented. The features of two- and three-point finite-difference schemes are discussed, including their nonconservation property. The properties of the local one-dimensional scheme proposed by the authors are investigated, and it is shown that the scheme is economical and conservative. To illustrate the efficiency of the schemes the results of the numerical investigation of the many-dimensional Schroedinger equation with logarithmic nonlinearity are presented. DOE

**N89-14789#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
**NUMERICAL SCHEMES IN THE STABILIZATION METHOD FOR NONLINEAR DIFFERENTIAL EQUATIONS OF SECOND ORDER**
T. Zhanlav and I. V. Puzynin 1987 19 p In RUSSIAN; ENGLISH summary
(DE88-703773; JINR-R-11-87-722) Avail: NTIS (US Sales Only)
HC A03/MF A01

The stabilization method is used for solving nonlinear differential equations of second order. One sufficient condition of a solution is given. Computational scheme is based on the continuous analog of the Newton method and spline-collocation method. The convergence of iterative procedure and of approximate solution are proved. The efficiently of the constructed algorithm is illustrated by numerical examples. DOE

**N89-14790#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
**SUPERCONFORMAL ALGEBRAS IN TWO DIMENSIONS**
S. A. Apikyan and T. M. Mishonov 1987 8 p In RUSSIAN; ENGLISH summary
(DE88-703786; JINR-R-17-87-405) Avail: NTIS (US Sales Only)
HC A02/MF A01

SO(N) is obtained-invariant algebra of extended superconformal symmetry in two dimensions with arbitrary central containing besides the energy-momentum tensor the current dimensions 1/2, and 3/2. DOE

**N89-14791#** Naval Postgraduate School, Monterey, CA.
**B-SPLINE-BEZIER REPRESENTATION OF TAU-SPLINES Technical Report, May - Jul. 1988**
Dieter Lasser (Technische Hochschule, Darmstadt, West Germany)
Jul. 1988 18 p
(AD-A197937; NPS53-88-006) Avail: NTIS HC A03/MF A01 CSCL 12A

This document presents a B-spline-Bezier representation of tau splines, curvature and torsion continuous quintics which have been introduced in CAGD by Hagen in 1985. Explicit formulas are given for the conversion of the B-spline-Bezier representation to the tau spline representation and vice versa, and conditions and certain ranges of tension values are derived which insure the positivity of the design parameters. GRA

**N89-14792#** Maryland Univ., College Park. Inst. for Physical Science and Technology.
**DETERMINING CONDUCTIVITY BY BOUNDARY MEASUREMENTS: SOME NUMERICAL RESULTS Final Technical Note**
In-Ja B. Lee May 1988 26 p
(Contract N00014-85-K-0169; NSF DMS-86-01490)
(AD-A198014; BN-1076) Avail: NTIS HC A03/MF A01 CSCL 12B

We consider the problem of determining an unknown conductivity by boundary measurements. First we briefly review various known results about uniqueness and continuous dependence. The main emphasis of this paper is on the discussion of some numerical results for a variational algorithm to recover the conductivity. GRA

**N89-14793#** Rome Univ. (Italy). Dept. of Mathematics.
**NUMERICAL OPTIMIZATION Periodic Report, No. 5, Jan. - Jul. 1988**
Francesco Zirilli Jul. 1988 46 p
(Contract DAJA45-86-C-0028)
(AD-A198586; R/D-5265-MA-01-5) Avail: NTIS HC A03/MF A01 CSCL 12D

Topics addressed include: The inverse gravimetry problem (an application to the northern San Francisco craton granite), and serial and parallel solution of large scale linear programs by augmented Lagrangian successive overrelaxation. B.G.

**N89-14794*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**UNIVERSAL LIMITER FOR TRANSIENT INTERPOLATION MODELING OF THE ADVECTIVE TRANSPORT EQUATIONS: THE ULTIMATE CONSERVATIVE DIFFERENCE SCHEME**
B. P. Leonard Sep. 1988 117 p
(NASA Order C-99066-G)
(NASA-TM-100916; ICOMP-88-11; E-4169; NAS 1.15:100916)
Avail: NTIS HC A06/MF A01 CSCL 12A

A fresh approach is taken to the embarrassingly difficult problem of adequately modeling simple pure advection. An explicit conservative control-volume formation makes use of a universal limiter for transient interpolation modeling of the advective transport equations. This ULTIMATE conservative difference scheme is applied to unsteady, one-dimensional scalar pure advection at constant velocity, using three critical test profiles: an isolated sine-squared wave, a discontinuous step, and a semi-ellipse. The goal, of course, is to devise a single robust scheme which achieves sharp monotonic resolution of the step without corrupting the other profiles. The semi-ellipse is particularly challenging because of its combination of sudden and gradual changes in gradient. The ULTIMATE strategy can be applied to explicit conservation schemes of any order of accuracy. Second-order schemes are unsatisfactory, showing steepening and clipping typical of currently popular so-called high resolution shock-capturing of TVD schemes. The ULTIMATE third-order upwind scheme is highly satisfactory for most flows of practical importance. Higher order methods give predictably better step resolution, although even-order schemes generate a (monotonic) waviness in the difficult semi-ellipse

simulation. Little is to be gained above ULTIMATE fifth-order upwinding which gives results close to the ultimate for which one might hope. Author

**N89-14795*#** California Univ., Los Angeles. Lab. for Flight Systems Research.
**EFFICIENT LOAD MEASUREMENTS USING SINGULAR VALUE DECOMPOSITION Final Report, 1 Jan. 1987 - 31 Mar. 1988**
Kung Yao and A. V. Baląkrishnan 1988 18 p
(Grant NAG2-433)
(NASA-CR-184614; NAS 1.26:184614) Avail: NTIS HC A03/MF A01 CSCL 12A

Various basic research was performed on efficient load measurement estimation techniques for aircraft structure analysis. An overview is presented of the load measurement problem. Two basic equivalent approaches to load measurement evaluations were considered. Under approach 1, the load values are modeled as depending linearly on the measured values. Under approach 2, the measured values depend linearly on the load values. By using the modern Singular Value Decomposition method, it was shown that under all conditions of the number of loads and number of gages, approach 1 is equivalent to approach 2. By using the conventional normal equation (linear regression) approach, approach 1 is only valid when the number of loads is equal to or greater than the number of gages, while approach 2 is the reverse. Furthermore, except for the case of the number of loads equals the number of gages, the load prediction formulas under the two approaches are not equivalent. Author

**N89-14796#** Technische Hogeschool, Delft (Netherlands).
**AN ASYMPTOTIC ANALYSIS OF A CLASS OF NONLINEAR HYPERBOLIC EQUATIONS Ph.D. Thesis**
Wilhelm Tenius vanHorssen 1988 133 p
(ETN-89-93352) Avail: NTIS HC A07/MF A01

An asymptotic theory is presented for a class of initial boundary value problems for weakly nonlinear wave equations with an application to a model of the galloping oscillations of overhead transmission lines. The weakly semilinear telegraph equations, asymptotic theory and application are also discussed. The asymptotics for the galloping oscillations of overhead transmission lines are examined and approximations are given. Its validity is demonstrated. ESA

**N89-14797#** Direction des Recherches Etudes et Techniques, Paris (France).
**STUDY OF THE DISCRETE MODELS OF THE BOLTZMANN EQUATION Final Report [ETUDE DES MODELES DISCRETS DE L'EQUATION DE BOLTZMANN]**
7 Sep. 1987 26 p Partly in ENGLISH and FRENCH
(Contract DRET-86-1507)
(DRET-86-1507/DS/SR; ETN-89-93602) Avail: NTIS HC A03/MF A01

The principle of the method of lattice gases is explained. This method allows the simulation of fluid motions by considering particles moving between one vertex and another in either a regular plane or a three-dimensional network. These networks can contain several million vortices. The motions obtained from this method are compared to the motions modeled by the classical macroscopic equations and also to the known real motions. ESA

**N89-14798*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**ON HILBERT-SCHMIDT NORM CONVERGENCE OF GALERKIN APPROXIMATION FOR OPERATOR RICCATI EQUATIONS Final Report**
I. G. Rosen (University of Southern California, Los Angeles.) Nov. 1988 20 p Submitted for publication
(Contracts NAS1-18107; NAS1-18605)
(NASA-CR-181755; ICASE-88-71; NAS 1.26:181755) Avail: NTIS HC A03/MF A01 CSCL 12A

An abstract approximation framework for the solution of operator algebraic Riccati equations is developed. The approach taken is based on a formulation of the Riccati equation as an abstract nonlinear operator equation on the space of Hilbert-Schmidt operators. Hilbert-Schmidt norm convergence of solutions to generic finite dimensional Galerkin approximations to the Riccati equation to the solution of the original infinite dimensional problem is argued. The application of the general theory is illustrated via an operator Riccati equation arising in the linear-quadratic design of an optimal feedback control law for a 1-D heat/diffusion equation. Numerical results demonstrating the convergence of the associated Hilbert-Schmidt kernels are included. Author

**N89-14799*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**SINGLE-GRID SPECTRAL COLLOCATION FOR THE NAVIER-STOKES EQUATIONS Final Report**
Christine Bernardi, Claudio Canuto, Yvon Maday, and Brigitte Metivet (Electricite de France, Clamart.) Nov. 1988 51 p Submitted for publication
(Contracts NAS1-18107; NAS1-18605)
(NASA-CR-181754; ICASE-88-69; NAS 1.26:181754) Avail: NTIS HC A04/MF A01 CSCL 12A

The aim of the paper is to study a collocation spectral method to approximate the Navier-Stokes equations: only one grid is used, which is built from the nodes of a Gauss-Lobatto quadrature formula, either of Legendre or of Chebyshev type. The convergence is proven for the Stokes problem provided with inhomogeneous Dirichlet conditions, then thoroughly analyzed for the Navier-Stokes equations. The practical implementation algorithm is presented, together with numerical results. Author

**N89-14800*#** Hampton Inst., VA. Dept. of Mathematics.
**AN EXAMPLE OF A HARMONIZABLE PROCESS WHOSE SPECTRAL DOMAIN IS NOT COMPLETE**
A. G. Miamee and H. Salehi (Michigan State Univ., East Lansing.) [1989] 7 p
(Grant NAG1-768)
(NASA-CR-184653; NAS 1.26:184653) Avail: NTIS HC A02/MF A01 CSCL 12A

The question of completeness of the spectral domain of harmonizable processes has been open for some years. An example is given of a harmonizable process whose spectral domain is not complete. This shows that a recent result which claims the completeness of all such spectral domains is false. Author

**N89-14906*#** Hampton Inst., VA.
**MODIFYING PASVART TO SOLVE SINGULAR NONLINEAR 2-POINT BOUNDARY PROBLEMS Abstract Only**
James P. Fulton *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 57-58 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 12A

**N89-14923*#** College of William and Mary, Williamsburg, VA. Dept. of Mathematics.
**GENERALIZED EIGENVALUES FOR PAIRS ON HERITIAN MATRICES Abstract Only**
George Rublein *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 93 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 12A

# 65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

**N89-14801#** Katholieke Universiteit, Nijmegen (Netherlands). Psychologisch Lab.
**ROBUSTNESS OF MARGINAL MAXIMUM LIKELIHOOD ESTIMATION IN THE RASCH MODEL**
Aeilko H. Zwinderman and Arnold L. vandenWollenberg 1987 26 p Sponsored by Nederlandse Organisatie voor Zuiver

Wetenschappelijk Onderzoek, The Hague
(PB88-209374; Rept-87-MA-09) Avail: NTIS HC A03/MF A01 CSCL 12A

Estimation of item parameters in the Rasch model by means of MML (Marginal Maximum Likelihood) is considered equivalnet to estimation of item parameters by means of Conditional Maximum Likelihood, and estimation of parameters of the latent ability distribution. The paper questions how much the accuracy and efficiency of MML estimates are affected by specifying a normal prior, while the actual latent ability distribution is skewed. It also studies the effect of specifying an invalid prior upon the first-order statistic, and compares the approach to the conditional approach. GRA

**N89-14802#** Los Alamos National Lab., NM. Theoretical Div.
**GREEN'S FUNCTION MONTE CARLO CALCULATIONS OF 4He**
Joseph A. Carlson 1988 16 p Presented at the Conference on Electron Scattering from Nuclei, Marciana Marina, Italy, 7 Jun. 1988
(Contract W-7405-eng-36)
(DE89-000379; LA-UR-88-2920; CONF-8806234-2) Avail: NTIS HC A03/MF A01

Green's Function Monte Carlo methods have been developed to study the ground state properties of light nuclei. These methods are shown to reproduce results of Faddeev calculations for A = 3, and are then used to calculate ground state energies, one- and two-body distribution functions, and the D-state probability for the alpha particle. Results are compared to variational Monte Carlo calculations for several nuclear interaction models. DOE

**N89-14803#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
**ESTIMATION OF PARAMETERS AND THE GOODNESS-OF-FIT TEST FOR MULTIVARIATE DISTRIBUTIONS FOR DATA PRESENTED AS ONE-DIMENSIONAL HISTOGRAMS**
N. I. Chernov, G. A. Ososkov, and V. S. Kurbatov 1987 13 p In RUSSIAN; ENGLISH summary
(DE88-703697; JINR-E-5-87-698) Avail: NTIS (US Sales Only) HC A03/MF A01

The problem of estimating parameters of multiwire probability distributions and testing hypothesis in the framework of physical experiments where data are presented as one-dimensional histograms for every single variable separately are studied. A commonly used method of some of chi squared -statistics over all single variables is investigated. It is shown that this method is incorrect for dependent variables. A correct generalization of this method is proposed for which analogs of classical theorems concerning asymptotic distributions of chi squared -statistics are proved for testing hypothesis and estimating parameters. The proposed method is implemented as a FORTRAN-4 program and illustrated by a numerical example for some model of pion-nucleon interactions. DOE

**N89-14804#** Texas A&M Univ., College Station. Dept. of Statistics.
**A NOTE ON SECOND ORDER EFFECTS IN A SEMIPARAMETRIC CONTEXT Technical Report No. 6, Aug. 1987 - Aug. 1988**
Raymond J. Carroll and Wolfgang Haerdle Aug. 1988 20 p
(Contract F49620-85-C-0144)
(AD-A198018; AFOSR-88-0845TR) Avail: NTIS HC A03/MF A01 CSCL 12C

Consider a heteroscedastic linear regression model with normally distributed errors in which the variances depend on an exogenous variable. Suppose that the variance function can be parameterized as psi(z sub i, theta) with theta unknown. If theta is any root-N consistent estimate of theta based on squared residuals, it is well known that the resulting generalized (weighted) least squares estimate with estimated weights has the same limit distribution as if theta were known. The covariance of this estimate can be expanded to terms of order 1/N-sq. If the variance function is unknown but smooth, the problem is adaptable, i.e., one can estimate the variance function nonparametrically in such a way that the resulting generalized least square estimate has the same first order normal limit distribution as if the variance function were completely specified. A special case is computed for an expansion for the covariance in this semiparametric context, and the rate of convergence is found to be slower for this estimate than for its parametric counterpart. More importantly, there is an effect due to how well one estimates the variance function. A kernel regression estimator is used to find that the optimal bandwidth in the problem is of the usual order, but the constant depends on the variance function as well as the particular linear combination being estimated. GRA

**N89-14805#** Texas A&M Univ., College Station.
**A NOTE ON EXTENDED QUASI-LIKELIHOOD Technical Report No. 7, Aug. 1987 - Aug. 1988**
M. Davidian and R. J. Carroll (North Carolina Univ., Chapel Hill.) Aug. 1988 18 p
(Contract F49620-85-C-0144)
(AD-A198042; AFOSR-88-0841TR) Avail: NTIS HC A03/MF A01 CSCL 12C

We study the method of extended quasi-likelihood estimation and inference of a variance function recently proposed by Nelder and Pregibon (1987). The estimates are inconsistent in general, and the test levels can be biased, but in many cases such as the exponential family the inconsistency and bias will not be a major concern. Extended quasi-likelihood is compared with Carroll and Ruppert's (1982) pseudo-likelihood method, which gives consistent estimates and, when slightly modified, asymptotically unbiased tests. We quantify the showing in this instance that the two estimates are closely related and may be asymptotically equivalent in many important cases. However, in some cases outside the exponential family, an asymptotic bias can persist. GRA

**N89-14806#** North Carolina Univ., Chapel Hill. Center for Stochastic Processes.
**ON EXCEEDANCE POINT PROCESSES FOR STATIONARY SEQUENCES UNDER MILD OSCILLATION RESTRICTIONS Technical Report No. 230, Sep. 1987 - Aug. 1988**
M. R. Leadbetter and S. Nandagopalan Apr. 1988 19 p
(Contract F49620-85-C-0144)
(AD-A198314; AFOSR-88-0838TR) Avail: NTIS HC A03/MF A01 CSCL 12C

It is known that any point process limits for the (time normalized) exceedances of high levels by a stationary sequence is necessarily Compound Poisson, under general dependence restrictions. This results from the clustering of exceedances where the underlying Poisson points represent cluster positions, and the multiplicities correspond to cluster sizes. A class of stationary sequences satisfying a mild local dependence condition restricting the extent of local rapid oscillation is investigated. For this class, criteria are given for the existence and value of the so-called extremal index which plays a key role in determining the intensity of cluster positions. Cluster size distributions are investigated for this class and in particular shown to be asymptotically equivalent to those for lengths of runs of consecutive exceedances above the level. Relations between the point processes of exceedances, cluster centers, and upcrossings are discussed. GRA

**N89-14807#** North Carolina Univ., Chapel Hill. Dept. of Statistics.
**NONPARAMETRIC ESTIMATION OF OPTIMAL PERFORMANCE CRITERIA IN QUALITY ENGINEERING Technical Report No. 8, Aug. 1987 - Aug. 1988**
R. J. Carroll and Peter Hall (Australian National Univ., Canberra.) Aug. 1988 29 p
(Contract F49620-85-C-0144)
(AD-A198315; AFOSR-88-0839TR) Avail: NTIS HC A03/MF A01 CSCL 12D

Box (1987) and Leon et al. (1987) discuss the problem of closeness to target in quality engineering. If the mean response f(x,z) depends on (x,z), the variance function is a PERMIA if it is g(z), i.e., depends only on z. The goal is to find (x sub o, z sub o) which minimizes variance while achieving a target mean value.

The authors pose and answer the question: for given smoothness assumptions about f and g, how accurately can we estimate x sub o and z sub o. As part of the investigation, they also find optimal rates of convergence for estimating f,g and their derivatives. GRA

**N89-14808#** North Carolina Univ., Chapel Hill. Psychometric Lab.
**BASE RATE EFFECTS ON THE INTERPRETATION OF PROBABILITY AND FREQUENCY EXPRESSIONS Interim Report, Nov. 1984 - Nov. 1985**
Thomas S. Wallsten, Samuel Fillenbaum, and James A. Cox Jun. 1988 46 p
(Contract MDA903-83-K-0347; DA Proj. 2Q1-61102-B-74-F)
(AD-A198456; ARI-RN-88-45) Avail: NTIS HC A03/MF A01 CSCL 05H

Two studies were run to determine whether the interpretations of statements or forecasts using vague probability and frequency expressions such as likely, improbable, frequently, rarely, were sensitive to the base rates of the events involved. In the first experiment, professional weather forecasters judged situations drawn from a medical context. In the second, students judged matched forecast scenarios of common semantic content that differed only in prior probability (as determined by an independent group of subjects). Results were: (1) The interpretations of forecasts using neutral terms (e.g., possible) and terms above neutral (e.g., usually) were strong, positive functions of base rate, while the interpretations of forecasts using terms below neutral (e.g., rarely) were much less affected by base rates; (2) In the second experiment interpretations of forecasts appeared to represent some kind of average of the meaning of the expression and the base rate. GRA

**N89-14809#** Princeton Univ., N. J. Statistics and Operations Research.
**THE ANALYSIS OF AVERAGES AND THE ANALYSIS OF VARIANCE**
Colin Goodall 1 Apr. 1988 31 p
(Contract DAAL03-86-K-0073)
(AD-A198467; SOR-88-7) Avail: NTIS HC A03/MF A01 CSCL 12C

In the analysis of averages and analysis of variance of a balanced array, repeated sweeping out of margin summaries has several advantages. These include the use of resistant summaries as alternatives to the mean, an exploratory emphasis, and computational convenience. The advantages offset the computational inefficiency of the sweep method relative to the Yates algorithm. However, analysis of averages and variance is not straightforward using the sweep function commonly found in data analysis software. Part 1 describes an invariant data structure and enhancements to sweep to provide computation of degrees of freedom and organization and annotation of a sequence of sweeps. The usual analysis of variance and median polish are defaults for the enhanced functions. Part 2 and the Appendix detail the specific implementation in S. GRA

**N89-14810*#** California Univ., Davis.
**COMPUTATION OF CANONICAL CORRELATION AND BEST PREDICTABLE ASPECT OF FUTURE FOR TIME SERIES**
Mohsen Pourahmadi and A. G. Miamee (Hampton Inst., VA.) [1989] 18 p
(Grants NAG1-768; NSF DMS-86-01858)
(NASA-CR-184655; NAS 1.26:184655) Avail: NTIS HC A03/MF A01 CSCL 12A

The canonical correlation between the (infinite) past and future of a stationary time series is shown to be the limit of the canonical correlation between the (infinite) past and (finite) future, and computation of the latter is reduced to a (generalized) eigenvalue problem involving (finite) matrices. This provides a convenient and essentially, finite-dimensional algorithm for computing canonical correlations and components of a time series. An upper bound is conjectured for the largest canonical correlation. Author

# 66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

**N89-14811#** Office of Technology Assessment, Washington, D.C.
**SDI (STRATEGIC DEFENSE INITIATIVE): TECHNOLOGY, SURVIVABILITY AND SOFTWARE**
May 1988 289 p
(PB88-236245; OTA-ISC-353; LC-87-619857) Avail: NTIS HC A13/MF A01; also available SOD HC $12.00 as 052-003-01084-4 CSCL 12B

The status of the various Strategic Defense Initiative (SDI) technologies and system components is reviewed. The feasibility of producing dependable software of the complexity that advanced ballistic missile defense (BMD) would require is analyzed. What is now known and unknown about the probable survivability of such systems against conserted enemy attacks of various kinds is summarized. Author

# 67 THEORETICAL MATHEMATICS

Includes topology and number theory.

**N89-14812#** Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
**ON THE LABELING AND SYMMETRY ADAPTATION OF THE SOLVABLE FINITE GROUPS REPRESENTATIONS**
A. O. Caride, S. I. Zanette, and S. R. A. Nogueira 1987 17 p
(DE88-703954; CBPF-NF-021/87) Avail: NTIS (US Sales Only) HC A03/MF A01

We propose a method to simultaneously perform a symmetry adaptation and a labeling of the bases of the irreducible representations of the solvable finite groups. It is performed by defining a self-adjoint operator with eigenvalues which evidence the descent in symmetry of the group-subgroups sequences. We also prove two theorems on the canonicity of the composition series of the solvable groups. DOE

**N89-14813#** Technische Hogeschool, Delft (Netherlands).
**SEMIGROUPS OF OPERATORS, APPROXIMATION AND SATURATION IN BANACH SPACES Ph.D. Thesis**
Cornelis Albertus Timmermans 1987 193 p
(ETN-89-93353) Avail: NTIS HC A09/MF A01

Operators in Banach spaces which generate semigroups of operators are investigated and the results are applied to saturation problems in approximation theory. The uniform saturation class is examined stating and proving a variant of the Becker and Nessel result about uniform saturation. A characterization of the uniform saturation class for the Bernstein operators is presented. By suitable transformations this problem is reduced to the uniform saturation of positive contractions. ESA

# 70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

**N89-14814#** Princeton Univ., N. J. Statistics and Operations Research.
**SUNSET OVER BROWNISTAN**
Erhan Cinlar 1988 16 p
(Grant AF-AFOSR-0050-87; AF Proj. 2304)
(AD-A198443; AFOSR-88-0759TR) Avail: NTIS HC A03/MF A01 CSCL 12C

Consider a Brownian motion with a downward drift of rate a. Its maximum overall time has the exponential distribution with parameter 2a. Our aim is to study this maximum as a stochastic

process indexed by a. That process is related to the convex majorant of the standard Brownian motion and, through the latter, to a Poisson random measure. This connection is exploited to obtain various distributional results. The results are of interest in queueing theory. GRA

**N89-14911*#** Eureka Coll., IL. Math and Physics.
**LASER CLOCKS AND NEAR FIELD GRAVITY OF ROTATING OBJECTS Abstract Only**
Joseph C. Hafele *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 67-69 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20C

# 71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution*.

**N89-14815** Stanford Univ., Calif.
**OPTICAL PREDETECTION PROCESSING FOR PARTIALLY COHERENT SYSTEMS Ph.D. Thesis**
Roy Mark Matic 1988 166 p
Avail: Univ. Microfilms Order No. DA8808391

In most image acquisition and processing systems, imaging optics are used merely to acquire an image of the object. A postdetection filter is then used to perform all of the desired processing. The predetection imaging system designed to enhance the performance of the overall system yielding an improved processed image is investigated. The influence of the coherence of the illumination on the capabilities of the imaging system is examined. In one approach, the problem was cast as one of image estimation. The aim is to design the imaging system to enhance the processed image estimate. The imaging system was designed to work with a postdetection linear filter or to perform all of the processing prior to detection. The design of the imaging system is a nonlinear problem which was solved using parameter-optimization techniques. In a second approach, the problem was cast as one of filter design. The aim is to replace an ideal processing system, containing a computationally inefficient postdetection linear filter, with an equivalent optical/digital system that can implement the processing more quickly than could a purely digital processor. The predetection/optics was designed in conjunction with the postdetection digital filter to emulate the ideal system. Dissert. Abstr.

**N89-14816** Oxford Univ. (England).
**PHASE TRANSFORMATION AND ENHANCED NUCLEAR RESONANCE IN ACOUSTICS Ph.D. Thesis**
Cheng Hon Alfred Huan 1987 160 p
Avail: Univ. Microfilms Order No. BRD-81488

The effects of acoustic waves and their uses, in rare earth compounds, in the ares of magnetic phase transformations and nuclear resonance are examined. The circuitry and apparatus used are described and the procedures explained for calibration in order to make measurements of acousitic time-delay and attenuation. The phenomenon of enhanced nuclear acoustic resonance and its analogy with the intrinsic direct process of relaxation are discussed. Measurements of resonant attenuation are made in HoVO4, and TmPO4, and the relaxation rate by the direct process is calculated for the latter to compare with measurements by direct methods. A theory is proposed for the acoustic strain operator, and the acoustic potential calculated for the 4f electron of Ho34 in HoVO4 and of Tm34 in TmPO4. The source of nonresonant acoustic absorption in HoVO4 is examined in terms of relaxation processes within the first excited doublet of the Ho34 ground manifold, whose energies are modulated by (100) phonon modes. The magnetoelastic (ME) effects in DyAl garnet are explained, and the magnetic phase diagram is obtained by observing singularities in the acoustic propagation. Dissert. Abstr.

**N89-14817#** Wyoming Univ., Laramie. Dept. of Electrical Engineering.
**CONSIDERATION OF IONIZING RADIATION SHIELDING FOR OPTICAL FIBERS**
Thad J. Englert Jun. 1988 37 p Sponsored by National Telecommunications and Information Administration, Boulder, CO
(PB88-237029; NTIA-CR-88-40) Avail: NTIS HC A03/MF A01 CSCL 20F

A brief overview of nuclear radiation processes is presented. Units of radiation energy and dose are discussed. Interactions of radiation processes with matter are analyzed in order to understand radiation and its energy. Range is discussed in relation to structures of matter in representative materials. Specific emphasis is placed on interaction of these radiation processes with soils in order to consider the ultimate effects of radiation on optical fibers located in a medium of soil and soil types. The shielding effects of soils are analyzed for the purpose of understanding radiation damage to any buried cable that may contain optical fibers. GRA

**N89-14818#** Bolt, Beranek, and Newman, Inc., Canoga Park, CA.
**DETAILED DESIGN SPECIFICATION FOR A PROTOTYPE ASSESSMENT SYSTEM FOR AIRCRAFT NOISE (ASAN) Interim Report, 12 Feb. - 15 Oct. 1987**
Fidell Sanford, Michael Harris, and Nicholaas Reddinguis Jul. 1988 93 p
(Contract F33615-86-C-0530)
(AD-A197936; BBN-R-6499) Avail: NTIS HC A05/MF A01 CSCL 12G

The U.S. Air Force Noise and Sonic Boom Impact Technology (NSBIT) Program is sponsoring a multi-stage effort to create a computer system containing tools needed by the environmental planning community to perform a variety of tasks related to assessing the environmental impacts of aircraft noise on people, animals, and structures. This interim report provides a detailed design specification for a prototype version of the NSBIT Assessment System for Aircraft Noise (ASAN) that is the major project of the first stage of this effort. The purposes and expected uses of ASAN are presented in Fidell and Harris (1987). The general functional capabilities of this system are described by Harris and Fidell (1987). The current report describes the organization of ASAN, its functional capabilities, and its major software modules. GRA

**N89-14819** National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
**A NATIONAL INTERCOMPARISON OF HYDROPHONE CALIBRATION METHODS Final Report**
S. P. Robinson, R. C. Preston, and D. R. Bacon Jun. 1988 57 p
(NPL-AC-116; ISSN-0143-7143; ETN-89-93571) Copyright
Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

Ten participants carried out measurements to determine the open-circuit voltage sensitivity of the hydrophones for the 250 Hz to 500 kHz range. The results for each participant are presented along with an overall comparison and assessment of the results. In almost every case, the maximum difference between the participants' results and the grand means of all the results exceeds the uncertainties (95 percent confidence level) for that particular participant. Maximum differences are frequently greater than 1 dB and sometimes greater than 3 dB. The estimates of uncertainty were in many cases too optimistic. Only 1 participant was capable of producing a set of results consistent with overall uncertainties of + or - 1 dB (95 percent confidence level). ESA

**N89-14820*#** Planning Research Corp., Hampton, Va.
**USERS' MANUAL FOR THE LANGLEY HIGH SPEED PROPELLER NOISE PREDICTION PROGRAM (DFP-ATP)**
M. H. Dunn and G. M. Tarkenton Washington, DC NASA Jan. 1989 46 p
(Contract NAS1-18000)

(NASA-CR-4208; NAS 1.26:4208) Avail: NTIS HC A03/MF A01 CSCL 20A

The use of the Dunn-Farassat-Padula Advanced Technology Propeller (DFP-ATP) noise prediction program which computes the periodic acoustic pressure signature and spectrum generated by propellers moving with supersonic helical tip speeds is described. The program has the capacity of predicting noise produced by a single-rotation propeller (SRP) or a counter-rotation propeller (CRP) system with steady or unsteady blade loading. The computational method is based on two theoretical formulations developed by Farassat. One formulation is appropriate for subsonic sources, and the other for transonic or supersonic sources. Detailed descriptions of user input, program output, and two test cases are presented, as well as brief discussions of the theoretical formulations and computational algorithms employed. Author

**N89-14821*#** Planning Research Corp., Hampton, Va. Aerospace Technologies Div.

**NUMERICAL SIMULATION AND COMPARISON OF SYMMETRICAL/SUPERCRITICAL AIRFOILS FOR THE NEAR TIP REGION OF A HELICOPTER IN FORWARD FLIGHT**

F. F. Badavi Washington, DC NASA Jan. 1989 54 p (Contract NAS1-18000)

(NASA-CR-4212; NAS 1.26:4212) Avail: NTIS HC A04/MF A01 CSCL 20A

Aerodynamic loads on a multi-bladed helicopter rotor in forward flight at transonic tip conditions are calculated. The unsteady, three-dimensional, time-accurate compressible Reynolds-averaged thin layer Navier-Stokes equations are solved in a rotating coordinate system on a body-conformed, curvilinear grid of C-H topology. Detailed boundary layer and global numerical comparisons of NACA-0012 symmetrical and CAST7-158 supercritical airfoils are made under identical forward flight conditions. The rotor wake effects are modeled by applying a correction to the geometric angle of attack of the blade. This correction is obtained by computing the local induced downwash velocity with a free wake analysis program. The calculations are performed on the Numerical Aerodynamic Simulation Cray 2 and the VPS32 (a derivative of a Cyber 205 at the Langley Research Center) for a model helicopter rotor in forward flight. Author

# 72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

**N89-14822** New South Wales Univ., Kensington (Australia).

**NUCLEAR SPIN COOLING USING ANTIFERROMAGNETIC MAGNONS Ph.D. Thesis**

J. P. D. Martin 1987 3 p

Avail: Issuing Activity

The problem of nuclear spin relaxation in antiferromagnetic insulating salts (AIS), in the milli-Kelvin region is examined. A review of the various low energy modes in AIS, at low temperatures, is presented and discussed. Close attention is paid to the way in which the magnon and nuclear excitations interact with each other, via the magnetic hyperfine interaction AIS. The contribution of the low energy excitations to the total specific heat and thermal conductivity is also described. The nuclear orientation techniques (NO) and its application to model systems is examined. The description of gamma-ray emission patterns from oriented nuclei is discussed within the elegant framework of irreducible tensor operators. It is shown how the random phase approximation can be used to compute Fano statistical tensors for many body systems such as Van Vleck enhanced nuclear systems, and antiferromagnets, where the electronic and nuclear subsystems are coupled together through the hyperfine interaction AIS. A description of the experimental apparatus used to obtain the results is presented. Details are given of both the dilution refrigerator performance, and the on-line data analysis and storage of the NO data. Author

**N89-14823** New South Wales Univ., Kensington (Australia). School of Physics.

**METHODS OF ANALYSIS OF COUPLED SPIN-LATTICE RELAXATIONS AND SPIN DIFFUSION IN HETEROGENEOUS ORGANIC SOLIDS WITH APPLICATION TO KERATIN**

Greg Simms Apr. 1987 4 p

Avail: Issuing Activity

Nuclear magnetic resonance pulse techniques were used to study the heterogeneous morphology of dry and hydrated keratin specimens. Specifically, two phase lamellar morphology was investigated. The Goldman-Shen and the Edzes and Samulski selective excitation pulse sequences were used to provide, respectively, information regarding the domain dimensions and the intrinsic spin-lattice relaxation rates of the two proton population resolved by the spin-spin relaxation. The analysis of these techniques led to expressions defining the diffusion dynamics of two phase systems. In particular, the induction of spin-lattice relaxation in one phase to experimentally control the magnetization density experienced by the surface of the adjoining phase domains was considered. Under certain conditions estimates of the domain dimension of the phase were made. Note that the inclusion of the spin-lattice relaxation functionally in the diffusion process enables the determination of the spin-lattice relaxation in a two phase system in which the net magnization relaxation is nonexponential. Author

**N89-14824*#** Eloret Corp., Sunnyvale, CA.

**SIMULATION STUDIES FOR SURFACES AND MATERIALS STRENGTH Semiannual Progress Report, 1 May - 31 Oct. 1988**

Timur Halicioglu 14 Nov. 1988 25 p (Contract NCC2-297)

(NASA-CR-183378; NAS 1.26:183378) Avail: NTIS HC A03/MF A01 CSCL 20H

During this six month period of the Simulation Studies for Surfaces and Materials Strength program investigations were carried out in two general areas: (1) Energy barriers and structural transitions between isomers of small Al clusters were investigated. In this study an empirical potential function which was parametrized based on accurate first principle results was employed; (2) A comparative study was conducted to investigate the applicability of most commonly employed model potential functions in calculating various bulk, surface and small cluster properties. Author

**N89-14825*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

**EVOLUTION OF PHOTON AND PARTICLE SPECTRA IN COMPACT, LUMINOUS OBJECTS Final Report, Aug. 1985 - Sep. 1988**

Jean A. Eilek, Lawrence J. Caroff, and Peter D. Noerdlinger (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 23 Nov. 1988 11 p (Contract NCC2-364)

(NASA-TM-101247; NAS 1.15:101247) Avail: NTIS HC A03/MF A01 CSCL 20H

The physics of high energy photons and particles (especially electrons and positrons) in the compact, high-energy-density of galactic nuclei and quasars was investigated. A numerical code was developed which follows the nonlinear spectral evolution of a pair/photon plasma, due to two-body scattering and interaction process, in an unmagnetized system. The code was applied both to static plasmas and to relativistic expanding winds. B.G.

**N89-14826#** Chicago Univ., IL.

**MOLECULAR BEAM STUDIES OF SURFACE PHONONS AND GAS SURFACE INTERACTIONS Interim Technical Report No. 11**

Steven J. Sibener 15 Jun. 1988 5 p (Contract N00014-86-K-0254)

(AD-A198435) Avail: NTIS HC A02/MF A01 CSCL 20L

Angle and velocity resolved inelastic helium scattering is becoming an incisive tool for probing the vibrational characteristics

of clean and adsorbate covered surfaces. These experiments can be visualized as being a two-dimensional (i.e., surface sensitive) analog to inelastic neutron scattering, which has played such a crucial role in elucidating the nature of elementary excitations in bulk crystals. In this paper a general review is presented of our recent work which demonstrates how the surface vibrational properties of epitaxially grown rare gas films evolve, on a layer-by-layer basis, towards those characteristic of thick crystals. Lattice dynamics calculations are used to quantitatively analyze the data. GRA

**N89-14827#** California Univ., Santa Barbara. Dept. of Physics.
**SEMICLASSICAL CORRECTIONS FOR INELASTIC ATOM-SURFACE SCATTERING FROM CLASSICAL TRAJECTORIES Technical Report, No. 15, Jun. - Dec. 1988**
W. Kohn, J. H. Jensen, and P. Chang 15 Aug. 1988 34 p
(Contract N00014-84-K-0548)
(AD-A198636) Avail: NTIS HC A03/MF A01 CSCL 20E

Consider an atom scattered inelastically from a surface and derive a formula for the exact semiclassical limit of the expectation value of an arbitrary, smooth function of the scattered atom's final momentum. The formula expresses this semiclassical limit in terms of equilibrium correlations for the atoms which compose the surface and quantities which can be calculated from classical scattering trajectories. We give numerical results for a simple one-dimensional example and compare these results with those given by the trajectory approximation. GRA

**N89-14828** National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
**AN INTERCOMPARISON OF THE RADIUM MASS STANDARDS OF THE UK AND THE USSR**
P. Christmas, P. Cross, E. Gubkin, E. Holnova, M. Yudin, and D. I. Mendeleev Jun. 1988 20 p
(NPL-RS(EXT)-103; ISSN-0143-7135; ETN-89-93570) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

The National Radium Standards of the UK and the USSR were intercompared by means of measurements of a secondary standard. In the UK the determination of the radium element content of the secondary standard was accomplished by gamma-ray spectrometric comparison with the national standard while in the USSR an ionization chamber and a calorimeter were used. Good agreement is obtained between the three methods. The results also agree with that of a comparison with the National Radium Standard of the USA. ESA

**N89-14829#** Technische Hogeschool, Eindhoven (Netherlands).
**COLLISION PHENOMENA IN A QUANTUM GAS Ph.D. Thesis**
Laurentius Philippus deGoey 1988 144 p
(B8811778; ETN-89-93340) Avail: NTIS HC A07/MF A01

The theoretical aspects of quantum mechanics collision phenomena of atomic hydrogen gas at densities and temperatures for which degeneracy effects do not play a role are studied. A calculation of the effective bulk rate constant is presented. Kegan's approximation with respect to the initial state appears to be excellent, as long as the contribution to the transition probability is dominated by extended bound states. The dependance on the magnetic field strength becomes weak due to the incorporation of inelastic atom molecule scattering in the final state. ESA

# 73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

**N89-14830#** Los Alamos National Lab., NM.
**HIGH-POWER MICROWAVE SOURCE DEVELOPMENT AT LOS ALAMOS**
M. V. Fazio, J. Kinross-Wright, R. F. Hoeberling, and F. VanHaaften 1988 4 p Presented at the Linear Accelerator Conference, Williamsburg, VA, 3 Oct. 1988
(Contract W-7405-eng-36)
(DE89-000327; LA-UR-88-3278; CONF-881049-11) Avail: NTIS HC A02/MF A01

Experimental research is under way at Los Alamos to develop the large-orbit gyrotron and the resonant-cavity virtual cathode oscillator as very high power microwave sources. These sources, though still in an early stage of development, have demonstrated power outputs from the several hundred megawatt to the gigawatt level at various laboratories. These devices exhibit very narrow band output, making them candidates for future accelerator drivers. Our efforts are directed toward achieving repetitively pulsed operation at pulse lengths in the microsecond regime. To provide the pulsed power for these experiments, a 1-MV, 10-kA modulator with a 1-microsecond pulse length and a 5-Hz pulse-repetition frequency has been developed and is currently being assembled. The resonant-cavity virtual cathode source has achieved very narrow band output compared to the conventional free-running virtual cathode oscillator. Techniques are being developed for extracting the microwave power from both sources into the rectangular waveguide. The experimental effort is described and current experimental results are discussed. DOE

**N89-14831*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**NUCLEAR REACTOR POWER AS APPLIED TO A SPACE-BASED RADAR MISSION**
L. Jaffe, T. Fujita, R. Beatty, P. Bhandari, E. Chow, W. Deininger, R. Ewell, M. Grossman, T. Kia, and B. Nesmith (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) et al. 1988 17 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, CO, 31 Jul. 1988 Prepared in cooperation with Los Alamos National Lab., NM
(Contract W-7405-eng-36)
(NASA-TM-101200; NAS 1.15:101200; DE89-000341; LA-UR-88-3253; CONF-880702-23) Avail: NTIS HC A03/MF A01 CSCL 18E

The SP-100 Project was established to develop and demonstrate feasibility of a space reactor power system (SRPS) at power levels of 10's of kilowatts to a megawatt. To help determine systems requirements for the SRPS, a mission and spacecraft were examined which utilize this power system for a space-based radar to observe moving objects. Aspects of the mission and spacecraft bearing on the power system were the primary objectives of this study; performance of the radar itself was not within the scope. The study was carried out by the Systems Design Audit Team of the SP-100 Project. DOE

# 74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

**N89-14832#** Los Alamos National Lab., NM.
**RADIATION-INDUCED TRANSIENT ABSORPTION IN SINGLE MODE OPTICAL FIBERS**
Larry D. Looney and Peter B. Lyons 1988 9 p Presented at SPIE O-E Lase: International Symposium and Exhibition on Fiber Optics, Optoelectronics and Laser Applications, Boston, MA, 6 Sep. 1988
(Contract W-7405-eng-36)
(DE89-000392; LA-UR-88-2782; CONF-8809105-3) Avail: NTIS HC A02/MF A01

This paper reviews the measurements conducted by the Los Alamos National Laboratory in support of these NATO efforts wherein radiation-induced transient absorption was measured over time ranges from a few ns to several microns for two single mode fibers. Experimental conditions were varied to provide data for future development of standarized test conditions for single mode fibers. DOE

**N89-14833#** Lawrence Livermore National Lab., CA.
**USE OF LASER DIODES FOR ANALOG FIBER OPTIC DIAGNOSTICS SYSTEMS**
K. G. Hagans, R. E. Haigh, and H. D. Francis 22 Aug. 1988 6 p Presented at SPIE O-E Lase: International Symposium and Exhibition on Fiber Optics, Optoelectronics and Laser Applications, Boston, MA, 6 Sep. 1988
(Contract W-7405-eng-48)
(DE88-017012; UCRL-99457; CONF-8809105-4) Avail: NTIS HC A02/MF A01

Because the time resolution requirements of experiments at the Nevada Test Site exceed the capabilities of traditional electrical analog cable, fiber optic analog diagnostics systems have become attractive. A number of different instrumentation systems are possible using commercially available laser-diode transmitters. In addition, the fiber optic systems designer has a choice of receivers, operating wavelengths, and fiber types. We will compare the system performance of 810-nm systems with both single-mode and multimodel fiber as well as 1300-nm single-mode fiber systems with both a photodiode oscilloscope and a laser-diode streak-camera receiver. DOE

**N89-14834#** Hughes Research Labs., Malibu, CA.
**MECHANISMS OF RADIATION DAMAGE GENERATED BY IONIZING RADIATION IN OPTICAL WAVEGUIDES Final Report, 1 Jun. 1984 - 31 Dec. 1987**
Robert N. Schwartz Sep. 1988 116 p
(Contract DAAG29-84-C-0005)
(AD-A198030; HAC-REF-F7182; ARO-20676.5-MS) Avail: NTIS HC A06/MF A01 CSCL 20F

Radiation damage generated by ionizing radiation (UV- and gamma-radiation) was studied in a variety of optical preforms and fiber-optic waveguides. The materials investigated included germanium-doped silica preforms and fibers, fluorine-doped silica, and heavy metal fluoride glass. Radiation damage and aging effects in bulk and fiber were also investigated. Electron paramagnetic resonance and optical spectroscopies were used to study the centers generated by the ionizing radiation. A parallel study of the intrinsic bonding defects in SiO2 films grown by a variety of techniques was also carried out. GRA

**N89-14835#** California Univ., Irvine. Dept. of Electrical Engineering.
**INTEGRATED ACOUSTOOPTIC DEVICE MODULES FOR OPTICAL INFORMATION PROCESSING Interim Report No. 8, 1 Mar. 1987 - 28 Feb. 1988**
Chen S. Tsai 18 Jul. 1988 20 p
(Grant AF-AFOSR-0378-85; AF Proj. 2305)
(AD-A198061; AFOSR-88-0734TR) Avail: NTIS HC A03/MF A01 CSCL 09F

The objectives of this program year are focused on design, fabrication, and testing of wideband guided wave AO Bragg diffraction from surface acoustic waves in Gallium arsenide optical waveguides and conception/realization of multichannel integrated acousto-optics and electrooptics Bragg modulator modules in TIPE microlenses-based lithium niobates and GaAs channel-planar composite waveguides with applications to signal processing and computing. Wideband GaAs waveguide AO Bragg cells that operate in the acoustic frequency range from 300 to 1200 MHz have been realized. This represents realization of GHz GaAs waveguide AO Bragg cells shows that monolithically integrated optic signal processors such as radiofrequency spectrum analyzers may be fabricated in a common GaAs chip. Multichannel single-mode electrooptic cutoff modulator arrays and Bragg diffraction modulator arrays have been successfully realized in GaAs. One of the vital and remaining components toward monolithic (total) integration in GaAs is the waveguide microlens and linear lens array. Fabrication of negative index-change planar waveguide microlenses in both LiNbO3 and GaAs using ion milling. The waveguide lenses that have been fabricated and tested include single lenses and lens arrays of analog Fresnel, chirp grating, and hybrid analog Fresnel chirp grating types. We have obtained near diffraction-limited spot sizes and good efficiencies in such preliminary components. GRA

**N89-14836#** Arizona Univ., Tucson. Optical Sciences Center.
**DETECTOR EVALUATION FOR OPTICAL SIGNALS**
Hans Roehrig and Michael P. Browne Mar. 1988 36 p
(Contract N66001-85-D-0203)
(AD-A198133; NOSC/TD-1244) Avail: NTIS HC A03/MF A01 CSCL 09A

Central to our work was the analysis of an RCA 8852 photomultiplier tube (PMT), received from Dr. Sam Green of the McDonnell-Douglas Corporation. We also worked on an image intensifier, supplied by Bill Flynt of the Varo Corporation. For the RCA 8852, the emphasis was on: Quantum efficiency as a function of wavelength, Relative responsitivity as a function of position over the useful area of the photocathode, Anode current as a function of temperature, and Dark electron pulse-height distribution. In particular, it was important to evaluate the dark current of the RCA 8852 PMT as a function of temperature. Because of its high dark current at room temperatures, it is impossible to obtain single electron pulse-height distributions with our system. GRA

**N89-14837#** Oregon Graduate Center for Study and Research, Beaverton.
**DETERMINATION OF OPTICAL PROPERTIES BY INVERSION OF MULTIPLE SCATTERING DATA: EXPERIMENTAL PROGRAM Final Report, 1 Mar. 1984 - 29 Feb. 1988**
Richard A. Elliott 13 May 1988 12 p
(Contract DAAG29-84-K-0038)
(AD-A198518; ARO-21047.2-G5) Avail: NTIS HC A03/MF A01 CSCL 04A

An experimental study designed to test the effectiveness of a time dependent inverse radiative transfer algorithm for determining the single scatter properties of optically thick media is described. The inversion algorithm required measurements of the time resolved backscattered radiance following ultrafast pulsed illumination of model, optically thick, atmospheres. Most of the measurements were accomplished with 532 nm, 35 ps duration pulses from a frequency doubled, passively mode locked Nd:YAG laser and a 10 ps resolution streak camera. The last series of measurements was made with a synchroscan streak camera and 5 ps duration pulses from a dye laser synchronously pumped with an acousto-optically mode-locked Argon ion laser. The experimental data were analyzed under a companion project: Determination of Optical Properties by Inversion of Multiple Scattering Data: Analytic Program. It was shown that it is possible to estimate the single scatter albedo of weakly absorbing particles with a relative error of less than 1 percent. scattering. GRA

# 75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**N89-14838#** Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands).
**APPLICATION OF INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROSCOPY ANALYSIS WITH A POLYCHROMATOR/MONOCHROMATOR COMBINATION THE BYPRODUCTS OF COAL-FIRED POWER STATIONS**
C. A. Weers 1987 18 p Submitted for publication
(PB88-226535; ISBN-90-353-0053-X) Avail: NTIS HC A03/MF A01 CSCL 20I

The by-products of coal-fired power plants may be hazardous for the environment. Good analysis methods are therefore required in order to establish either a possible usage of the by-products or their possible storage. Preliminary experiments performed with inductively coupled plasma atomic emission spectroscopy have proven very successful. Moreover, the method is cost-effective. A short description is given of the optimized system for routine analysis. The system consists of a 2- and a 15-channel

polychromator in combination with a monochromator. The opportunities is provides are also described. Use of the monochromator to analyze coal and run-off water from the flue-gases desulphurization, and of the polychromators to analyze coal fly-ash is described separately. GRA

**N89-14839#** Office of Technology Assessment, Washington, D.C.
**STARPOWER: THE US AND THE INTERNATIONAL QUEST FOR FUSION ENERGY, CONTRACTOR DOCUMENTS Final Report**
Wilfrid L. Kohl, Leonard H. Lynn, Kuniko Yamada Lynn, and Paul R. Josephson Oct. 1987 185 p
(PB88-214663) Avail: NTIS HC A09/MF A01 CSCL 20I

The political aspects of fusion research in Europe and Japan are discussed. The history and politics of energy technology of controlled thermonuclear synthesis research in the U.S.S.R. are discussed. Author

**N89-14840** New South Wales Univ., Kensington (Australia).
**LASER GENERATED LARGE AMPLITUDE LONGITUDINAL FIELDS IN INHOMOGENEOUS PLASMA WITH SECOND HARMONIC SUPER DENSITY RESONANCES AND QUASI-UNIFORM CORONAL OSCILLATIONS Ph.D. Thesis**
Michael Philip Goldsworthy Feb. 1988 3 p
Avail: Issuing Activity

The generation of large amplitude oscillating longitudinal electric fields, resulting from the interaction of intense laser radiation with inhomogeneous plasma, is investigated. In particular, the second harmonic longitudinal field, driven by the nonlinear ponderomotive force, is analyzed for steady state laser plasma interaction. The genuine two fluid model is generalized to a three dimensional discription of laser plasma interaction. Particular emphasis is given to the formulation of the two fluid unaveraged nonlinear force from first principles. Detailed analysis of the second harmonic component of the dynamic electric field is based on the approximation of linear density gradients. For the case of normal incidence of laser light, the analysis was conducted separately for coronal and evanescent regions. Because of this study, a more detailed and realistic hydrodynamic description is provided of laser plasma interaction. The analysis of the laser generated second harmonic fields suggest that they may be stronger, more widespread and therefore more important to laser fusion than previously thought. Author

**N89-14841#** Naval Ship Research and Development Center, Bethesda, MD.
**TRANSIENT MAGNETOHYDRODYNAMIC LIQUID-METAL FLOWS IN A RECTANGULAR CHANNEL WITH A MOVING CONDUCTING WALL Final Report**
Frederick J. Young, Samuel H. Brown, and Neal A. Sondergaard May 1988 27 p Prepared in cooperation with Frontier Timber Co., Bradford, PA
(AD-A197308; DTRC-88/017) Avail: NTIS HC A03/MF A01 CSCL 20D

The magnetohydrodynamic equations for temporal transients have been formulated and solved for a liquid metal flowing in a rectangular channel. The rectangular channel was a perfectly conducting moving top wall and a perfectly conducting stationary bottom wall in the presence of an applied external magnetic field aligned perpendicular to the conducting walls. The side walls of the channel are stationary insulators. Calculations show that the temporal transients of the fluid velocity and induced magnetic intensity comprise two exponentially decaying parts. One fast transient is believed to be associated with the propagation of Alven waves and the other a slow transient being the result of viscous and electrical diffusion. Curves of the transients are presented at several stations in the channel. GRA

**N89-14842*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**LUNAR HELIUM-3 AND FUSION POWER**
Washington, DC Sep. 1988 234 p Workshop held in Cleveland, Ohio, 25-26 Apr. 1988
(NASA-CP-10018; E-4254; NAS 1.55:10018) Avail: NTIS HC A11/MF A01 CSCL 20I

The NASA Office of Exploration sponsored the NASA Lunar Helium-3 and Fusion Power Workshop. The meeting was held to understand the potential of using He-3 from the moon for terrestrial fusion power production. It provided an overview, two parallel working sessions, a review of sessions, and discussions. The lunar mining session concluded that mining, beneficiation, separation, and return of He-3 from the moon would be possible but that a large scale operation and improved technology is required. The fusion power session concluded that: (1) that He-3 offers significant, possibly compelling, advantages over fusion of tritium, principally increased reactor life, reduced radioactive wastes, and high efficiency conversion, (2) that detailed assessment of the potential of the D/He-3 fuel cycle requires more information, and (3) D/He-3 fusion may be best for commercial purposes, although D/T fusion is more near term. For individual titles, see N89-14843 through N89-14853.

**N89-14843*#** Wisconsin Univ., Madison. Fusion Technology Inst.
**THE MOON: AN ABUNDANT SOURCE OF CLEAN AND SAFE FUSION FUEL FOR THE 21ST CENTURY** **c91**
G. L. Kulcinski and Harrison H. Schmitt (Schmitt, Harrison H., Albuquerque, NM ) *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 35-64 Presented at the 11th International Scientific Forum on Fueling the 21st Century, Moscow (USSR), 29 Sep. - 6 Oct. 1987 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

It is shown how helium-3 can be obtained from the moon and how its use in fusion reactors can benefit the inhabitants of this planet. The physics and technology issues associated with the use of He-3 is addressed. A description is given of He-3 distribution on the moon and of methods which could be used to retrieve it. Author

**N89-14844*#** Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Nuclear Engineering and Engineering Physics.
**HELIUM-3 BLANKETS FOR TRITIUM BREEDING IN FUSION REACTORS**
Don Steiner, Mark Embrechts, Georgios Varsamis, Roger Vesey, and Paul Gierszewski (Canadian Fusion Fuels Technology Project, Toronto, Ontario ) *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 65-71 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 20I

It is concluded that He-3 blankets offers considerable promise for tritium breeding in fusion reactors: good breeding potential, low operational risk, and attractive safety features. The availability of He-3 resources is the key issue for this concept. There is sufficient He-3 from decay of military stockpiles to meet the International Thermonuclear Experimental Reactor needs. Extraterrestrial sources of He-3 would be required for a fusion power economy. Author

**N89-14845*#** Illinois Univ., Urbana. Fusion Studies Lab.
**STATUS OF FUSION RESEARCH AND IMPLICATIONS FOR D/He-3 SYSTEMS**
George H. Miley *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 73-99 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 20I

World wide programs in both magnetic confinement and inertial confinement fusion research have made steady progress towards the experimental demonstration of energy breakeven. However, after breakeven is achieved, considerable time and effort must still be expended to develop a usable power plant. The main program described is focused on Deuterium-Tritium devices. In magnetic confinement, three of the most promising high beta approaches with a reasonable experimental data base are the Field Reversed Configuration, the high field tokamak, and the dense

Z-pinch. The situation is less clear in inertial confinement where the first step requires an experimental demonstration of D/T spark ignition. It appears that fusion research has reached a point in time where an R and D plan to develop a D/He-3 fusion reactor can be laid out with some confidence of success. Author

**N89-14846*#** Wisconsin Univ., Madison. Fusion Technology Inst.
**STRATEGY FOR D/He-3 FUSION DEVELOPMENT**
John F. Santarius *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 101-113 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 20I

It is concluded that Deuterium/Helium-3 fusion faces a more difficult physics development path but an easier technology development path than does Deuterium/Tritium. Early D/He-3 tests in next generation D/T fusion experiments might provide a valuable D/He-3 proof-of-principle at modest cost. At least one high leverage alternate concept should be vigorously pursued. Space applications of D/He-3 fusion are critically important to large scale development. Author

**N89-14847*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**LUNAR HYDROGEN: A RESOURCE FOR FUTURE USE AT LUNAR BASES AND SPACE ACTIVITIES** **c91**
Everett K. Gibson, Jr., Roberta Bustin (Arkansas Coll., Batesville.), and David S. McKay *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 115-127 Presented at the Symposium on Lunar Bases and Space Activities in the 21st Century, Houston, TX, 5-7 Apr. 1988 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

Hydrogen abundances were determined for grain size separates of five lunar soils and one soil breccia. The hydrogen abundance studies have provided important baseline information for engineering models undergoing study at the present time. From the studies is appears that there is sufficient hydrogen present in selected lunar materials which could be recovered to support future space activities. It is well known that hydrogen can be extracted from lunar soils by heating between 400 and 800 C. Recovery of hydrogen for regolith materials would involve heating with solar mirrors and collecting the released hydrogen. Current baseline models for the lunar base are requiring the production of 1000 metric tons of oxygen per year. From this requirement it follows that around 117 metric tons per year of hydrogen would be required for the production of water. The ability to obtain hydrogen from the lunar regolith would assist in lowering the operating costs of any lunar base. Author

**N89-14848*#** Wisconsin Univ., Madison. Fusion Technology Inst.
**PROCESSES AND ENERGY COSTS FOR MINING LUNAR HELIUM-3** **c91**
I. N. Sviatoslavsky *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 129-146 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

Preliminary investigations show that obtaining He-3 from the moon is technically feasible and economically viable. With the exception of beneficiation, the proposed procedures are state of the art. Mass of equipment needed from earth is of some concern, but resupply will eventually be ameliorated by the use of titanium from indigenous ilmenite. A complete energy payback from a D/He-3 fusion reactor utilizing lunar He-3 is approx. 80, providing ample incentive for commercial investment is forthcoming. Byproducts will be of great value to the resupply of a permanent lunar base and enhancement of space exploration. Author

**N89-14849*#** Schmitt (Harrison H.), Albuquerque, NM.
**ECONOMIC GEOLOGY OF LUNAR HELIUM-3** **c91**
Harrison H. Schmitt *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 147-157 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

Economic geology evaluation of lunar He-3 should answer the question: Can lunar He-3 be sold on Earth with sufficient profit margins and low enough risk to attract capital investment in the enterprise. Concepts that relate to economic geology of recovering He-3 from the lunar maria are not new to human experience. A parametric cost and technology evaluation scheme, based on existing and future data, is required to qualitatively and quantitatively assess the comprehensive economic feasibility and return on investment of He-3 recovery from the lunar maria. There are also many political issues which must be considered as a result of nuclear fusion and lunar mining. Author

**N89-14850*#** Wisconsin Univ., Madison. Fusion Technology Inst.
**MINING FOR HELIUM: SITE SELECTION AND EVALUATION** **c91**
Eugene N. Cameron *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 159-168 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

Part of the University of Wisconsin study of the feasibility of recovering He-3 from the moon is selection and evaluation of potential mining sites. Selection and evaluation are based primarily on salient findings by investigators: (1) Regoliths from areas underlain by highland materials contain less than 20 wppm He; (2) Regoliths of certain maria or parts of maria also contain less than 20 wppm He, but mare regoliths at the Apollo 11 and 17 sites contain 25 to 49 wppm He; (3) The helium content of a regolith is a function of its composition; and (4) Helium is concentrated in the -50 micron size fractions of regoliths. In site selection, the concern is with the compositions of lunar regoliths, in particular with their titanium contents. It is widely accepted that compositions of mare regoliths are controlled by the nature of the underlying basalts from which the regoliths are largely derived. The distribution and extent of the three groups of basalts and the regoliths derived from them are the first basis for site selection and evaluation. Other considerations are briefly discussed. Author

**N89-14851*#** Fusion Power Associates, Gaithersburg, MD.
**COMMERCIAL OBJECTIVES, TECHNOLOGY TRANSFER, AND SYSTEMS ANALYSIS FOR FUSION POWER DEVELOPMENT**
Stephen O. Dean *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 169-192 Submitted for publication (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 20I

Fusion is an inexhaustible source of energy that has the potential for economic commercial applications with excellent safety and environmental characteristics. The primary focus for the fusion energy development program is the generation of central station electricity. Fusion has the potential, however, for many other applications. The fact that a large fraction of the energy released in a DT fusion reaction is carried by high energy neutrons suggests potentially unique applications. In addition, fusion R and D will lead to new products and new markets. Each fusion application must meet certain standards of economic and safety and environmental attractiveness. For this reason, economics on the one hand, and safety and environment and licensing on the other, are the two primary criteria for setting long range commercial fusion objectives. A major function of systems analysis is to evaluate the potential of fusion against these objectives and to help guide the fusion R and D program toward practical applications. The transfer of fusion technology and skills from the national labs and universities to industry is the key to achieving the long range objective of commercial fusion applications. Author

**N89-14852*#** Astronautics Technology Center, Madison, WI.
**SYNERGISM OF He-3 ACQUISITION WITH LUNAR BASE EVOLUTION** **c91**

Thomas M. Crabb and Mark K. Jacobs *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 193-210 Presented at the Symposium on Lunar Bases and Space Activities in the 21st Century, Houston, Tex., 5-7 Apr. 1988 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

It is shown how acquisition of He-3 affects Lunar Base development and operation. A four phase evolutionary Lunar Base scenario is summarized with initial equipment mass and resupply requirements. Requirements for various He-3 mining operations are shown and available by-products are identified. Impacts of mining He-3 on Lunar Base development include increases in equipment masses to be delivered to the lunar surface and a reduction of Lunar Base resupply based on availability of He-3 acquisition by-products. It is concluded that the acquisition of this valuable fusion fuel element greatly enhances the commercial potential of a Lunar Base. Author

**N89-14853*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**ASSESSMENT OF LUNAR SOURCES OF He-3 FOR USE ON EARTH c91**
Robert E. English *In its* Lunar Helium-3 and Fusion Power Sep. 1988 p 227-231 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

As a gross measure of the economics of mining lunar sources of He-3, the energy densities (GJ/ton) of lunar soils were compared with the energy densities of various existing and future terrestrial sources of energy. On this basis, only the very richest lunar ores appear competitive with coal. Future lunar exploration might emphasize identification of lunar soils having higher concentrations of He-3. Author

**N89-14854#** Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
**LOW ACTIVATION MATERIALS FOR FUSION**
A. F. Rowcliffe, E. E. Bloom, D. G. Doran, D. L. Smith, and T. C. Reuther (Department of Energy, Washington, DC.) 1988 8 p Presented at the 12th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Nice, France, 12 Oct. 1988
(Contract DE-AC05-84OR-21400)
(DE88-015561; CONF-881015-4; IAEA-CN-50/G-3-2) Avail: NTIS HC A02/MF A01

The viability of fusion as a future energy source may eventually be determined by safety and environmental factors. Control of the induced radioactivity characteristics of the materials used in the first wall and blanket could have a major favorable impact on these issues. In the United States, materials program efforts are focused on developing new structural alloys with radioactive decay characteristics which would greatly simplify long-term waste disposal of reactor components. A range of alloy systems is being explored in order to maintain the maximum number of design options. Significant progress has been made, and it now appears probable that reduced-activation engineering alloys with properties at least equivalent to conventional alloys can be successfully developed and commercialized. DOE

**N89-14855#** Los Alamos National Lab., NM.
**THE PHYSICS OF THE HIGH DENSITY Z-PINCH**
A. H. Glasser, J. E. Hammel, H. R. Lewis, I. R. Lindemuth, G. H. McCall, R. A. Nebel, D. W. Scudder, J. S. Schlachter, R. H. Lovberg, and P. Rosenau (Technion - Israel Inst. of Tech., Haifa.) et al. 1988 11 p Presented at the 12th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Nice, France, 12 Oct. 1988 Prepared in cooperation with California Univ., Los Angeles
(Contract W-7405-eng-36)
(DE88-016147; LA-UR-88-2840; CONF-881015-5; IAEA-CN-50/C-4-4-1) Avail: NTIS HC A03/MF A01

The fiber-initiated High-Density Z-Pinch (HDZP) is a novel concept in which fusion plasma could be produced by applying 2 MV along a thin filament of frozen deuterium, 20 to 30 microns in diameter, 5 to 10 cm long. The megamp-range currents that result would ohmically heat the fiber to fusion temperatures in 100 ns while maintaining nearly constant radius. The plasma pressure would be held stably by the self-magnetic field for many radial sound transit times during the current-rise phase while, in the case of D-T, a significant fraction of the fiber undergoes thermonuclear fusion. This paper presents results of Los Alamos HDZP studies. Existing and new experiments are described. A succession of theoretical studies, including 1D self-similar and numerical studies of the hot plasma phase, 1D and 2D numerical studies of the cold startup phase, and 3D numerical studies of stability in the hot regime, are then presented. DOE

**N89-14856#** Washington Univ., Seattle. Dept. of Nuclear Engineering.
**REVIEW PROJECTS FOR THE US FUSION PROGRAM Progress Report, 1 Dec. 1984 - 28 Feb. 1987**
F. L. Ribe 15 Sep. 1988 12 p
(Contract DE-AS06-78ET-52047)
(DE88-017306; DOE/ET-52047/7; UWFPP-41) Avail: NTIS HC A03/MF A01

This paper reviews projects at the University of Washington on the following topics: Magnetic Fusion Energy Program Plan (Feb. 1985); High Density Power Systems; Fusion Systems Studies; Burning Plasmas and Compact Ignition Tokamak; U.S. Magnetic Mirror Program; and Technical Planning Activity (Jan. 1987). DOE

**N89-14857#** Washington Univ., Seattle. Dept. of Nuclear Engineering.
**HIGH TEMPERATURE BLANKETS FOR NON-ELECTRICAL/ELECTRICAL APPLICATIONS OF FUSION REACTORS Progress Report, 15 Jul. 1983 - 30 Nov. 1984**
F. L. Ribe and G. L. Woodruff 15 Aug. 1988 11 p
(Contract DE-AS06-78ET-52047)
(DE88-017307; DOE/ET-52047/6; UWFPP-40) Avail: NTIS HC A03/MF A01

We report a continuation of work done in collaboration with the Lawrence Livermore National Laboratory (LLNL) on design studies of the tandem-mirror fusion reactor (TMR) coupled to the General Atomic (GA) sulfur-iodine thermochemical process for producing hydrogen. During this report period the emphasis was on a solid-breeder gas cooled cannister blanket for TMR-based hydrogen production. This work was integrated with the Department of Energy (DOE), Office of Fusion Energy (OFE) Blanket Comparison and Selection Study, coordinated by the Argonne National Laboratory (ANL). The areas investigated by the two principal investigators and their students were the following: Plasma engineering of the TMR, including the magnets; Neutronics transport support for the synfuel blanket and shield; Completion of studies of the GA sulfur-iodine process. Under subcontract D.S. Rowe of Rowe and Associates worked with both UW and LLNL personnel on Mechanical design and thermal hydraulics of a high temperature, solid breeder blanket. DOE

**N89-14858#** General Atomic Co., San Diego, CA.
**TOROIDAL PINCH EXPERIMENTS IN OHTE WITH A RESISTIVE SHELL**
T. Tamano, W. D. Bard, C. M. Greenfield, R. J. LaHaye, M. J. Schaffer, and P. L. Taylor Sep. 1988 9 p Presented at the 12th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Nice, France, 12 Oct. 1988
(Contracts DE-AC03-84ER-53158; DE-FG03-86ER-53228)
(DE88-017339; GA-A-19393; CONF-881015-14; IAEA-CN-50/C-2-3) Avail: NTIS HC A02/MF A01

Reversed field pinch (RFP) experiments (edge safety factor q sub edge less than 0) and ultra low q (ULQ) experiments (0 less than q sub edge less than 1) were carried out in OHTE with a resistive shell. In the RFP experiments, active control of plasma equilibrium position greatly improved the reproducibility of discharges sustained over 10 ms. However, onset of simultaneous m = 0 and 1, toroidally localized, locked MHD modes often caused

discharge termination. Their amplitudes seem to increase with beta. ULQ discharges were sustained for up to 28 ms. The plasma exhibited a marked tendency toward constant current operation at favored q, suggesting plasma self-organization. The first ULQ discharges to break the radiation barrier are reported. DOE

**N89-14859#** Oak Ridge National Lab., Tenn.
**PANEL ON HIGH BETA AND/OR HIGH FIELD TOKAMAKS AND STELLARATORS**
John Sheffield 1988 4 p Presented at the Fusion Power Associates Annual Meeting and Symposium on the Creation of Compact, High Power Density Plasmas, Santa Fe, NM, 6 Sep. 1988
(Contract DE-AC05-84OR-21400)
(DE88-017367; CONF-880967-1) Avail: NTIS HC A02/MF A01

This paper discusses high beta aspects of the stellarators and tokamak reactors and the need to understand the MHD equations involved. DOE

**N89-14860#** Los Alamos National Lab., NM.
**EDGE-PLASMAS AND WALL PROTECTION IN RFPs (REVERSED-FIELD PINCH)**
Kenneth A. Werley, Charles G. Bathke, and Robert A. Krakowski 1988 6 p Presented at the 8th Topical Meeting on Technology of Fusion Energy, Salt Lake City, UT, 9 Oct. 1988
(Contract W-7405-eng-36)
(DE89-000386; LA-UR-88-2890; CONF-881031-11) Avail: NTIS HC A02/MF A01

The Reverse-Field Pinch (RFP) has the ability to operate as a compact, moderate-to-high beta, high-power-density system. A compact system requires careful control of the particle and heat fluxes impinging on plasma-facing components. A strongly recycling, toroidal-field open divertor combined with a highly radiating (greater than 90 percent of plasma heating power) core plasma is required. An open divertor configuration locates the plate near the field null to take advantage of the flux expansion and minimum poloidal asymmetries to minimize peak heat fluxes. The physics and engineering requirements are quantitatively discussed for an evolutionary sequence of impurity/ash-control schemes for AT-40M (0.4 MA) yields ZT-P (0.08 MA) yields ZTH (2-4 MA) yields FTF/RFP (10 MA) yields TITAN (18 MA). DOE

**N89-14861#** Los Alamos National Lab., NM.
**TECHNOLOGY AND PHYSICS IMPLICATIONS OF OSCILLATING-FIELD CURRENT DRIVE IN REVERSED-FIELD PINCHES**
Charles G. Bathke, Robert A. Krakowski, and Kurt F. Schoenberg 1988 7 p Presented at the 8th Topical Meeting on Technology of Fusion Energy, Salt Lake City, UT, 9 Oct. 1988
(Contract W-7405-eng-36)
(DE89-000388; LA-UR-88-2888; CONF-881031-9) Avail: NTIS HC A02/MF A01

The property of reversed-field pinches (RFPs) to relax to a near- minimum-energy state is the basis of oscillating-field current drive (OFCD), wherein plasma current is driven by modulating in quadrature the external toroidal and poloidal magnetic fields. Coupled plasma/circuit OFCD simulations of RFPs ranging from present experiments (ZT-P and ZT-40M) to the reactor (TITAN) indicate that the drive frequency and the amplitude of the plasma-current oscillations decrease with decreased plasma resistance so that minimum frequencies (approximately 25 Hz) and plasma-current amplitudes (approximately 1.6 percent) and maximum efficiencies (approximately 0.3 A/W) are attained in the reactor regime. Methods for minimizing the reactive powers and for optimizing the current-drive efficiency for OFCD in RFPs have been identified. DOE

**N89-14862#** Sandia National Labs., Albuquerque, N. Mex.
**PROGRESS TOWARD INERTIAL FUSION WITH LIGHT ION BEAMS AT SANDIA NATIONAL LABORATORIES**
J. P. Vandevender, J. E. Bailey, K. W. Bieg, D. L. Cook, J. T. Crow, M. P. Desjarlais, R. A. Gerber, S. A. Goldstein, R. A. Hamil, and G. T. Holman 1988 10 p Presented at the 12th International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Nice, France, 12 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-016693; SAND-88-2432C; CONF-881015-8; IAEA-CN-50/B-2-5) Avail: NTIS HC A02/MF A01

Inertial Confinement Fusion driven by lithium ion beams is being pursued on the Particle Beam Fusion Accelerator 2 at Sandia National Laboratories. Reliably synchronizing the 36 pulsed power modules has allowed the experiments on ion beam production and focusing to progress at the rate of one test per day. The accelerator has been operated at reduced energy to reproduce and extend the data base from previous accelerators. In this mode, 500 kJ are coupled to the diode, 425 kJ to the ion beam, 220 kJ to a single species, but only 75 kJ to the target. Solenoidal lens bending and diode impedance collapse from magnetic field diffusion into the anode plasma explain the inefficiency. The horizontal beam divergence needed for ignition (20 mrads) has been achieved. The divergence is smallest with small gaps between the anode and the virtual cathode. A 10 percent full width at half maximum variation in the instantaneous ion beam energy is recorded. The results are consistent with an electromagnetic instability, although other explanations are possible. The data and associated theory indicate that very high current density diode operation is desirable for efficient beam generation and focusing. The light ion approach to a Laboratory Microfusion Facility that will produce a range of thermonuclear yields from 200 to 1000 MJ is based on the magnetically insulated linear induction accelerator concept recently tested in Hermes 3. DOE

**N89-14863#** Arizona Univ., Tucson. Dept. of Chemistry.
**THE EFFECT OF TORCH PRESSURE ON ANALYTE RESPONSE IN A 27 MHz INDUCTIVELY COUPLED PLASMA**
Thomas R. Smith and M. B. Denton 4 Feb. 1988 4 p
(Contract N00014-86-K-0316)
(AD-A198595; TR-54) Avail: NTIS HC A02/MF A01 CSCL 14B

Recent studies employing an inductively coupled argon plasma system equipped with a torch capable of operating at pressures between 100 and 3000 torr are described. Results from these studies indicate two major areas of research where non-atmospheric pressure torch conditions can be utilized. The first of these areas is the elucidation of excitation and energy transfer mechanisms within the plasma. The effect of pressure on energy transfer mechanisms, electron densities and other excitation phenomenon are discussed and evaluated in light of recent plasma models. Data demonstrating shifts in the relative concentrations of excited state and ground state species will be presented along with spatial mapping of excitation temperatures and ion-to-atom ratios within the plasma. Additional data presented includes relative emission intensities for atomic and ionic emissions originating from high and low energy transitions. Such data is important in predicting plasma deviation from local thermal equilibrium conditions. Results of studies indicating a shift of plasma conditions toward local thermal equilibrium with increasing pressure and the implications for theoretical modeling of this trend are also discussed. GRA

**N89-14864#** FOM-Inst. voor Plasmafysica, Rijnhuizen, Jutphaas (Netherlands).
**[ACTIVITIES REPORT IN PLASMA PHYSICS] Annual Status Report**
31 Dec. 1987 88 p
(ETN-89-93377) Avail: NTIS HC A05/MF A01

Plasma pinches; turbulent heating in TORTUR and diagnostic studies; the RIP tokamak; the free electron laser for infrared experiments; laser produced X-ray sources; X-ray optics and spectroscopy; magnetohydrodynamics; wave dynamics; and transport problems are discussed. ESA

**N89-14865#** Technische Hogeschool, Eindhoven (Netherlands).
**MODELING OF RF PLASMAS IN A PARALLEL PLATE ETCH REACTOR Ph.D. Thesis**
Paul Martin Vallinga 1988 157 p Sponsored by the Stichting

voor Fundamenteel Onderzoek der Materie, Jutphaas, Netherlands
(B8811775; ETN-89-93344) Avail: NTIS HC A08/MF A01

Models based on an experimental etching device using a CF4/Ar plasma with two parallel electrodes are developed. The validity of the theoretical investigations is confirmed with experimental data obtained in a 13.56 MHz plasma experiment. The electron Boltzmann equation is analyzed in an inhomogeneous discharge including spatial gradients. The solution is based on an asymptotic expansion of the electron energy distribution function. The calculated electron density is in good agreement with the experimental data obtained by Bisschops. ESA

# 76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

**N89-14866#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
**STUDY OF THE LOCALIZED VIBRATIONS OF THE HYDROGEN IN SOLID SOLUTION Zr-O BY INELASTIC NEUTRON SCATTERING**
K. N. Kracjun, S. I. Morozov, I. Natkanets, and V. V. Sumin 1986 14 p In RUSSIAN; ENGLISH summary
(DE88-702945; JINR-R-14-86-857) Avail: NTIS (US Sales Only) HC A03/MF A01

Dynamics of implanted hydrogen and oxygen atoms in zirconium was investigated at 293 and 80 K and at different concentrations of impurity atoms. Hydrogen vibration energy is solid solution ZrO0.25H0.09 Planck constant approx. = 141 MeV is close to hydrogen vibration energy in sigma phase of zirconium hydride (Planck constant approx. = 138 MeV) changing under adequate conditions. In a specimen with low oxygen content ZrO0.03H0.01 hydrogen vibration energy coincides with maximum position of zirconium hydride optical band. It is suggested that, as in Ti-O-H system, at low oxygen content in Zr-O-H no complete suppression of hydride precipitation occurs. Data on structural analysis of ZrO0.37 and ZrO0.37D0.1 alloys are given. DOE

**N89-14867** Harvard Univ., Cambridge, MA.
**JOSEPHSON JUNCTION ARRAYS WITH POSITIONAL DISORDER: EXPERIMENTS AND SIMULATIONS Ph.D. Thesis**
Martin Gerard Forrester 1987 136 p
Avail: Univ. Microfilms Order No. DA8806080

The results are presented of Josephson junction arrays with positional disorder, using both experiments and Monte Carlo simulations. Fifty x fifty arrays were fabricated of Pb/Cu proximity effect junctions, with controlled positional disorder characterized by a parameter delta*. The zero field resistive transitions of these samples are well described by the Kosterlitz-Thouless Halperin-Nelson vortex unbinding theory. Measurements of resistance vs. magnetic field reveal rich structure, with pronounced minima at integer fields, as well as higher order structure. In samples with disorder, the principal oscillations are found to decay linearly with field, after accounting for the effect of the magnetic field on the critical currents of the individual junctions. Monte Carlo simulations of XY spin systems with positional disorder reveal reentrant behavior in the helicity modulus Y, which is the analog of the effective superfluid density in a junction array, in a narrow range of magnetic fields near the theoretical critical field. It is suggested that the complete reentrance proposed theoretically is prevented by either finite size effects or pinning of vortices due to the disorder. Dissert. Abstr.

**N89-14868*#** Rensselaer Polytechnic Inst., Troy, N.Y.
**CRYSTAL GROWTH OF CdTe IN SPACE AND THERMAL FIELD EFFECTS ON MASS FLUX AND MORPHOLOGY**
H. Wiedemeier 1988 11 p
(Grant NAGw-976)
(NASA-CR-183263; NAS 1.26:183263) Avail: NTIS HC A03/MF A01 CSCL 20L

The primary, long-range goals are the development of vapor phase crystal growth experiments, and the growth of technologically useful crystals in space. The necessary ground-based studies include measurements of the effects of temperature variations on the mass flux and crystal morphology in vapor-solid growth processes. For in-situ mass flux measurements dynamic microbalance techniques will be employed. Crystal growth procedures and equipment will be developed to be compatible with microgravity conditions and flight requirements. Emphasis was placed on the further development of crystal growth and the investigation of relevant transport properties of CdTe. The dependence of the mass flux on source temperature was experimentally established. The CdTe synthesis and pretreatment procedures are being developed that yield considerable improvements in mass transport rates, and mass fluxes which are independent of the amount of source material. A higher degree of stoichiometric control of CdTe than before was achieved during this period of investigation. Based on this, a CdTe crystal growth experiment, employing physical vapor transport, yielded very promising results. Optical microscopy and X-ray diffraction studies revealed that the boule contained several large sized crystal grains of a high degree of crystallinity. Further characterization studies of CdTe crystals are in progress. The reaction chamber, furnace dimensions, and ampoule location of the dynamic microbalance system were modified in order to minimize radiation effects on the balance performance. Author

**N89-14869#** National Bureau of Standards, Boulder, CO. Electromagnetic Technology Div.
**BREAK JUNCTIONS 1 Interim Report, 1 Oct. 1986 - 31 Sep. 1987**
John Moreland, L. F. Goodrich, J. W. Ekin, T. E. Capobianco, and A. F. Clark May 1988 74 p
(Contract N00014-86-F-0109)
(PB88-241849; NBSIR-88-3090) Avail: NTIS HC A04/MF A01 CSCL 20L

Measurements of the tunneling current-voltage characteristics of break junctions in conventional superconductors can be used to determine their superconducting energy gap as a function of energy. These results agree with those previously obtained using traditional oxide tunneling barriers. Break junctions in some exotic superconductors, on the other hand, have anomalous current-voltage characteristics compared to BCS predictions. Enery gaps and the Josephson effect measured for the high T sub c materials YBaCuO (t sub c = 93 K) and LaSrCuO (t sub c = 36 K) indicate that the samples are inhomogeneous with varying gap functions depending on the location of the tunneling contact within the break junction fracture. Break junction data for these materials are within the strong coupling limits of BCS theory. GRA

**N89-14870*#** National Aeronautics and Space Administration, Washington, DC.
**DIAMOND CHEMICAL VAPOR DEPOSITION APPARATUS**
Hideaki Matsubara, Hisashi Suzuki, Noritoshi Horie, and Kunio Shibuki Sep. 1988 12 p Transl. into ENGLISH of Japanese Patent no. JP 62216998 (Appl. no. 86/58964, 24 Sep. 1987) Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20380; NAS 1.77:20380) Avail: NTIS HC A03/MF A01 CSCL 20L

The title application is characterized by a cooling means provided for the substrate which is placed in a irradiation range of a thermionic emitter. The cooling means may be a supply of water or liquid nitrogen or He into hollow(s) in or pipes on the substrate holder, or movement of the substrate holder outside the irradiation range. A diamond film was grown at 3 microns/h and 980 degrees using a H2O-cooled Mo substate holder, while a diamond was grown at 0.3 microns/h and 1400 degrees without cooling.
Author

**N89-14871*#** Catholic Univ. of America, Washington, DC.
**APPLICATION OF LINEAR RESPONSE THEORY TO EXPERIMENTAL DATA OF SIMULTANEOUS RADIATION AND ANNEALING RESPONSE OF A CMOS DEVICE Quarterly Report No. 3, 8 Jun. - 8 Sep. 1988**
V. Litovchenko 1988 6 p
(Grant NAG5-864)
(NASA-CR-183401; NAS 1.26:183401) Avail: NTIS HC A02/MF A01 CSCL 20L

Results from the application of linear response theory are compared to experimental data from simultaneous radiation and annealing response of a CMOS device. In particular, a method is applied which was developed earlier to determine the characteristic time, t(0), as well as the parameters A and C in the 1n(t) dependence of the linear response function R(t) = -C + A1n(1-t/t(0)). The method is based on a study of the linear response for t being much less than t(0), when R(t) can be expanded in a power series of t: R(t) = R(0) + R'(0)t + 1/2R''(0)t-squared + 1/3R'''(0)t-cubed + ..., where R'(0) and R''(0) are, respectively, the first and second derivatives of R with respect to t. To find the linear response, R(t-t') is substituted in the form of this power series equation into a general equation for the shift of the threshold potential. To test the method, irradiation experiments were conducted on RCA 10(6) rad-hard CMOS IC's. A dose rate of approximately 130 rads/min was used. An IC was irradiated with Co-60 gamma rays for several hours, taking measurements of the threshold potential for one n-channel and one p-channel transistor every ten minutes. For the p-channel transistor, t(0) was found to be approximately 110 min and for the n-channel, t(0) was approximately 70 min. For the p-channel, the theoretical curve deviates from the experimental points only after 70 min; for the n-channel, the deviation takes place after 45 min. Additional findings are discussed and the application of the method to pure annealing is described. M.G.

**N89-14872#** Argonne National Lab., IL. Materials Science Div.
**CRITICAL FIELDS AND CHARACTERISTIC LENGTHS IN COPPER OXIDE SUPERCONDUCTORS**
G. W. Crabtree, W. K. Kwok, and A. Umezawa Feb. 1988 14 p Presented at the Discussion Meeting on High-/Tc/ Superconductors, Mauterndorf, Austria, 7 Feb. 1988
(Contract W-31-109-eng-38)
(DE89-000543; CONF-880207-7) Avail: NTIS HC A03/MF A01

There have been a number of studies of the critical fields and critical currents in the two copper oxide superconducting families La2-xSrxCuO4 and YBa2Cu3O7-delta which show unexpected and unusual properties. Resistive measurements of the superconducting transition in zero and finite field often show long tails extending to low temperatures, and the critical field curves constructed from such data often show unusual upward curvature, especially near T sub c. Initially most of the critical field studies were done on polycrystalline sintered samples. With such samples there is always a lingering question as to whether the measured properties are intrinsic to the material or are due to poor connections between particles or to the averaging of strongly anisotropic behavior over many crystallites orientations. We characterize the typical behavior of polycrystalline samples and compare it to results on single crystals. Much of the behavior seen in polycrystals also appears in single crystals and that among single crystal samples there is significant sample dependence. We combine information with new measurements of the lower critical field at low temperature to derive the anisotropic magnetic penetration depth. Finally, we compare the derived characteristic length with relevant unit cell dimensions and with the scale of the microstructure to infer information about the dimensionality of the superconductivity and the pinning forces in YBa2Cu3O7-delta. DOE

**N89-14873#** Argonne National Lab., IL.
**MAGNETIC FIELD PENETRATION INTO THE HIGH TEMPERATURE SUPERCONDUCTOR YBa2Cu3O(SUB 7-x)**
A. Mansour, R. O. Hilleke, G. P. Felcher, R. B. Laibowitz, P. Chaudhari, and S. S. P. Parkin (International Business Machines Corp., San Jose, CA.) Jul. 1988 12 p Presented at the 4th International Conference on Neutron Scattering (ICNS '88), Grenoble, France, 12 Jul. 1988
(Contract W-31-109-eng-38)
(DE89-000547; CONF-880715-9) Avail: NTIS HC A03/MF A01

The penetration depth of a magnetic field into a superconducting YBa2Cu3O(sub 7-x) film was measured by polarized neutron reflection. The sample comprised an epitaxial film with the c-axis of its orthorhombic structure perpendicular to the film's surface. Measurements at 14 K showed that a magnetic field (parallel to the surface) penetrates into the surface over a depth of 1400 A. DOE

**N89-14874#** California Univ., Berkeley. Lawrence Berkeley Lab. National Center for Electron Microscopy.
**Bi-Ca-Sr-Cu-O SUPERCONDUCTORS: THE CONNECTIVITY ISSUE**
R. Ramesh, G. Thomas, S. M. Green, C. Jiang, Y. Mei, and H. L. Luo (California Univ., San Diego, La Jolla.) Aug. 1988 16 p Presented at the Applied Superconductivity Conference, San Francisco, CA, 21 Aug. 1988
(Contract DE-AC03-76SF-00098)
(DE89-000558; LBL-25842; CONF-880812-7) Avail: NTIS HC A03/MF A01

The connectivity problem in Bi-Ca-Sr-Cu-O superconductors is addressed. Bulk samples always exhibit a step in the resistivity plot, consequent to which zero resistance is obtained around 75K, although the onset is above 110K. Magnetic measurements indicate the presence of almost equal fractions of two superconducting phases with transition temperatures of 110K and about 80K. The microstructure of these samples has been examined using several transmission electron microscopy techniques. The superconducting phases exhibit a polytypoid type structure with the general formula of Bi2Sr2Ca(sub n-1)Cu(sub n)O(sub y), where n takes on values of 1,2,3 and in some infrequent cases 4. The c-parameter and T sub c increase with n. In almost all the superconducting grains, the lower T sub c (n = 1 or 2) polytypoid is observed at the grain boundaries. Thus, the 110K polytypoid in each grain is not connected to similar regions in other grains. The lower T sub c polytypoid is observed at the grain boundaries due to a reduction Ca and/or Cu. It is suggeted that the controlled addition of PbO enables the formation of a Pb-rich liquid phase which makes the composition near the grain boundaries uniform. Consequently, the step in the resistivity plot disappears. DOE

**N89-14875#** California Univ., Berkeley. Lawrence Berkeley Lab.
**INVERSION BOUNDARIES IN GaAs GROWN ON Si**
Z. Liliental-Weber, M. A. OKeefe, and J. Washburn Aug. 1988 20 p Presented at the MAS/EMSA Microbeam Analysis Conference, Milwaukee, WI, 7 Aug. 1988
(Contract DE-AC03-76SF-00098)
(DE89-000568; LBL-25779; CONF-880841-21) Avail: NTIS HC A03/MF A01

Inversion boundaries in GaAs grown on Si were investigated by high-resolution transmission electron microscopy. These boundaries were found to microscopically follow (110) planes, even when they appeared macroscopically along other planes, such as (111). High resolution micrographs from edge-on (110) inversion boundaries were taken in (110) and (100) projection. In certain areas, shifts of the images of (111) and (200) planes across the boundaries were observed. Image simulations confirmed that the visibility of these shifts can only be observed for specific imaging conditions and within a limited range of sample thickness. DOE

**N89-14876#** Sandia National Labs., Albuquerque, N. Mex.
**SURFACE FLASHOVER THRESHOLD AND SWITCHED FIELDS OF PHOTOCONDUCTIVE SEMICONDUCTOR SWITCHES**
G. M. Loubriel, M. W. OMalley, F. J. Zutavern, B. B. McKenzie, and W. R. Conley 1988 14 p Presented at the Conference on Electrical Insulation and Dielectric Phenomena, Ottawa, Ontario, 16 Oct. 1988

(Contract DE-AC04-76DP-00789)
(DE88-011618; SAND-88-0729C; CONF-881084-1) Avail: NTIS HC A03/MF A01

We have shown that Si Photoconductive Semiconductor Switches (PCSS) can be used to switch high voltages (up to 123 kV), high fields (up to 82 kV/cm) and high currents (2.8 kA). The ability of the samples to withstand this type of high voltage, high current switching depends on the way in which the current penetrates the semiconductor. The appropriate use of water or contacts greatly improves the switching capability. We have also shown that the wafers can support large currents (4.0 kA for GaAs and 2.8 kA for Si) and large linear current densities (3.2 kA/cm for GaAs and 1.4 kA/cm for Si). For GaAs this linear current density corresponds to about 1 Ma cm² given a penetration depth of about 10 sup minus 3 cm. DOE

**N89-14877#** Lawrence Livermore National Lab., CA.
**PHOTONIC APPLICATIONS OF THIN FILM GaAs GROWN ON SILICON AND INSULATING SUBSTRATES BY MOLECULAR BEAM EPITAXY**
J. D. Morse, G. M. McWright, R. P. Mariella, E. M. Behymer, and W. H. Guthreau 1988 8 p Presented at the International Congress on Optical Science and Engineering, Hamburg, Fed. Republic of Germany, 11 Sep. 1988
(Contract W-7405-eng-48)
(DE88-016975; UCRL-98370; CONF-8809123-1) Avail: NTIS HC A02/MF A01

Thin film GaAs layers grown by Molecular Beam Epitaxy (MBE) on silicon, semi-insulating GaAs, and insulating substrates have been investigated for application to optoelectronic circuit technology. Photoconductivity measurements were conducted to characterize the electronic transport properties of the epitaxial layers in terms of carrier recombination lifetime and effective drift mobility. By varying the epitaxial growth parameters, it is possible to obtain various levels of material quality which are suitable for various components of optoelectronic integrated circuits. Results from photodetectors fabricated from GaAs grown on various layers will be presented. The fabrication of ridge waveguides from GaAs grown on silicon dioxide will also be described. Finally, a procedure for growing high quality GaAs for active devices in situ with layers for picosecond photoconductors will be discussed. DOE

**N89-14878#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
**MODIFIED SOLDERED JOINTS OF CURRENT-CARRYING SUPERCONDUCTORS**
I. N. Goncharov and L. Miu 1987 7 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE88-703754; JINR-R-8-87-315) Avail: NTIS (US Sales Only) HC A02/MF A01

The improved soldered joints of the composite superconductors are proposed. Their resistivity was measured under different variants of preparing at T=4.2 K and B less than or equal to 6T. DOE

**N89-14879#** Sandia National Labs., Albuquerque, N. Mex.
**LONG-LIVED RESONANCE STATES IN Si-DOPED AlGaAs**
H. P. Hjalmarson and T. J. Drummond 15 Aug. 1988 5 p Presented at the 15th International Conference on Defects in Semiconductors, Budapest, Hungary, 22 Aug. 1988
(Contract DE-AC04-76DP-00789)
(DE89-000305; SAND-88-0989C; CONF-8808106-4) Avail: NTIS HC A02/MF A01

Resonance states of impurities are shown to be long-lived if their coupling to the lattice is sufficiently large. The recombination of these states with band states is thermally activated which leads to extremely long lifetimes at low temperatures. Such states can explain recent experiments suggesting long-lived resonance states associated with persistent photoconductivity and DX-centers in Si-doped Al(sub 1-x)Ga(sub x)As for x less than. 0.2. DOE

**N89-14880#** Aerojet Electrosystems Co., Azusa, CA.
**Hg,CdTe MATERIAL OPTIMIZATION FOR CARRIER LIFETIME MAXIMIZATION Final Technical Report, 1 Sep. 1986 - 30 Apr. 1988**
Honnavalli R. Vydyanath 14 Jul. 1988 71 p
(Contract DAAL03-86-C-0019)
(AD-A198101; ARO-24540.1-EL) Avail: NTIS HC A04/MF A01 CSCL 20L

Hg(1-x)Cd(x)Te is a variable bandgap allow semiconductor which has recently emerged to perhaps the single most important infrared detector material with extensive military and civilian applications. The minority carrier lifetime in p-type base material for n(+)p photodiode structures is normally much below the radiative limit and is limited by the presence of Shockley-Read Centers which are related to the presence of impurities and native defects in the material. In order to obtain photo diode performance close to the theoretical limits, it is essential to prepare mercury cadmium telluride material with carrier lifetime approaching radiative limit. This is possible only when the origin of the Shockley-Read Centers limiting the carrier lifetime is established and the material preparation conditions are optimized so that the concentration of these centers is reduced to a minimum. The goal of the program was to optimize the preparation conditions of the (Hg,Cd)Te material such that the carrier lifetime was maximized. Both undoped and doped crystals were investigated. To begin with, indium as an n-type dopant was investigated. At the end of the duration of the program, the material had been optimized so that the p-type carrier concentration can be controllably reproduced via anneals under well defined thermodynamic conditions, namely temperature and partial pressure of Hg. The behavior of indium doped (Hg,Cd) Te was well established. GRA

**N89-14881#** Colorado State Univ., Fort Collins.
**SEMICONDUCTING TRANSITION METAL SILICIDES: NEW MATERIALS FOR OPTOELECTRONICS ON SILICON Final Report, 19 Mar. - 31 Dec. 1987**
John E. Mahan 31 May 1988 6 p
(Contract MIPR-ARO-136-87)
(AD-A198139; ARO-23475.4-MS) Avail: NTIS HC A02/MF A01 CSCL 11F

Semiconducting transition metal silicide thin films of FeSi2, MnSi1.7, CrSi2, ReSi2, and IrSi1.75, were prepared. The electronic band structures were probed with measurements of the optical properties as a function of photon energy, together with measurements of the electrical resistivity as a function of temperature. The iron and manganese silicides possess direct forbidden energy gaps of 0.89 and 0.68 eV, respectively. The chromium and rhenium silicides exhibited apparently indirect gaps of slightly less than 0.35 and 0.12 eV, respectively. The bandgap of IrSi1.75 is close to that of silicon and could not be determined with the techniques available to use in this research. Applications for the semiconducting silicides, in optoelectronic chip interconnects and infrared detection, are noted. GRA

**N89-14882#** Rutgers - The State Univ., Piscataway, N. J. Dept. of Civil and Environmental Engineering.
**ON THE USE OF 1-D FINITE ELEMENTS FOR THE TEMPERATURE BEHAVIOR OF A CONTOURED AND PARTIALLY PLATED SC-CUT RESONATOR**
Yook-Kong Yong 1987 8 p
(Contract DAAL03-87-K-0107)
(AD-A198309; ARO-25224.1-EL) Avail: NTIS HC A02/MF A01 CSCL 20B

A two-dimensional, Langrangean variational equation of motion for the incremental displacements superposed on homogenous thermal strains in an electrode plated crystal resonator was derived. A one-dimensional form of the equation was considered and solved using 1-D, cubic finite elements. The program was applied to the study of the f-T behavior of a contoured and partially plated SC-Cut quartz strip. The variable thickness in a contoured strip was interpolated using the same cubic finite element shape functions. Numerical convergence of the fundamental thickness shear frequency and its f-T curve was examined in meshes of increasing

fineness. A preliminary study was performed for the thickness shear mode and its f-T curve with respect to the electrode thickness and contour, including both the plano-convex and plano-Gaussian contoured surfaces. The plano-Gaussian strip has more parameters than the plano-convex strip in the control of f-T behavior and energy trapping. GRA

**N89-14883#** Harry Diamond Labs., Adelphi, MD.
**PREPARATION, STRUCTURE, AND SPECTROSCOPIC PROPERTIES OF nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 CRYSTALS Final Report, Feb. - Nov. 1987**
Toomas H. Allik, Susan A. Stewart, Dhiraj K. Sardar, Gregory J. Quarles, Richard C. Powell, Clyde A. Morrison, Gregory A. Turner, Milan R. Kokta, Wayne W. Hovis, and Albert A. Pinto (Center for Night Vision and Electro-Optics, Fort Belvoir, VA.) Aug. 1988 33 p
(AD-A198476; HDL-TR-2148) Avail: NTIS HC A03/MF A01 CSCL 07B

Single crystals of lanthanum lutetium gallium garnet (LLGG) were grown by the Czochralski pulling technique. X-ray diffraction and elemental analysis performed on these samples indicate that these garnets do not form with simple stoichiometry described as (La) 3Lu2(Ga)3O12 but with increased Lu concentration in the dodecahedral site and Ga occupancy in the octahedral site. Optical absorption and fluorescence spectra confirm these results, showing inhomogeneous broadening of the spectral lines of Nd3+. Various laser gain measurements were performed on (La1-xLux) 3Lu1-yGay2(Ga)3O12 crystals containing 4.3 and 1.2 atomic percent Nd3+ to determine the usefulness of this material as a laser. No optical gain was observed. To ascertain why, time-resolved, site-selection spectroscopy measurements were made to determine the effects of ion/ion interaction, and two-photon excitation spectroscopy measurements were made to determine the effects of excited state absorption. The results show the presence of very weak energy transfer between ions in nonequivalent crystal-field sites and the presence of very strong two-photon absorption transitions. GRA

**N89-14884#** GTE Labs., Inc., Waltham, MA.
**TRANSPORT AND JUNCTION PHYSICS OF SEMICONDUCTOR-METAL EUTECTIC COMPOSITES Final Report, 1 Apr. 1986 - 31 Mar. 1988**
B. Ditchek and J. Gustafson Jun. 1988 104 p
(Contract F49620-86-C-0034)
(AD-A198480; AFOSR-88-0834TR) Avail: NTIS HC A06/MF A01 CSCL 20L

An investigation of the transport and junction physics of Si-TaSi2 semiconductor-metal eutectic composites has demonstrated the potential use of this class of materials in highpower switching. Following the development of single-crystal matrix Si-TaSi2 crystals, eutectic diodes utilizing the in situ junctions were fabricated and analyzed using current-voltage, capacitance-voltage, and electron-beam-induced current (EBIC) techniques. Studies demonstrated nearly ideal diode behavior, a Schottky barrier height of 0.62 eV, and a means of measuring the extent of the depletion zones and the carrier concentration of the semiconductor matrix. An analysis based on a comparison of the EBIC-determined carrier concentration with the Hall carrier concentration resulted in a measure of the effect of the depletion zones on composite resistivity. Building on the foundation provided by this analysis, the first eutectic composite transistors were demonstrated. These devices confirmed that current flow can be controlled by pinching off Si channels between TaSi2 rods. Furthermore, testing at high voltages indicated that the eutectic devices are resistant to avalanche breakdown. Devices have been built that block 600 V, three times the value for a conventional planar device in a wafer of the same carrier concentration. GRA

**N89-14885#** Illinois Univ., Urbana. Coll. of Engineering.
**ACOUSTIC PHONON SCATTERING IN MODULATION DOPED ALUMINUM (SUBx) GALLIUM (SUB 1x) ARSENIDE/GALLIUM ARSENIDE HETEROJUNCTIONS Ph.D. Thesis**
Stephen J. Manion Jul. 1988 109 p
(Contract N00014-84-C-0149)
(AD-A198512; UILU-ENG-88-2235) Avail: NTIS HC A06/MF A01 CSCL 20L

We investigate acoustic deformation potential scattering in A1xGa1-xAs/GaAs modulation doped heterojunctions. We review previous measurements of the deformation potential constant Z and discuss the controversy over the discrepancy between the measured value of Z in bulk GaAs and in the heterojunction. By comparing the theory of scattering in bulk GaAs with previously reported measurements of the mobility at 77K we determine an upper limit for the deformation potential constant of 11 eV. We experimentally measure the relationship between the electron temperature and the power loss, and we compare our measurements with theory. We conclude, in general agreement with previous measurements in heterojunctions, that a large value of the deformation potential constant (approximately 16 eV) would be necessary to fit the data using a theory of acoustic phonon scattering. GRA

**N89-14886#** Maryland Univ., College Park. Dept. of Chemistry and Biochemistry.
**MACROMOLECULAR CALCULATIONS IN THE XTAL SYSTEM OF CRYSTALLOGRAPHIC PROGRAMS Progress Report, Sep. 1987 - Jul. 1988**
James M. Stewart 1 Jul. 1988 3 p
(Contract N00014-88-K-0323)
(AD-A198525) Avail: NTIS HC A02/MF A01 CSCL 20B

This project is concerned with the production of crystallographic computer codes for the solution and refinement of macromolecular crystal structures. The computer programs are being prepared within the context of an existing suite of crystallographic computer programs called XTAL. Extensive documentation and testing is being done in addition to the programming. GRA

**N89-14887#** California Univ., Los Angeles. Dept. of Chemistry and Biochemistry.
**SOLID PHASE EQUILIBRIA IN THE Pt-Ga-As AND Pt-Ga-Sb SYSTEMS Technical Report No. 9, Aug. 1987 - Jul. 1988**
C. T. Tsai and R. Stanley Williams 22 Jul. 1988 26 p
(Contract N00014-87-K-0014)
(AD-A198654) Avail: NTIS HC A03/MF A01 CSCL 07B

Approximate Pt-Ga-As and Pt-Ga-Sb ternary phase diagrams were determined at room temperature with the use of X-ray powder diffraction data. Pt was found to react chemically with both GaAs and GaSb to produce Pt-Ga and Pt/group-V intermetallic compounds. Each semiconductor formed pseudo-binary systems with at least three different intermetallic compounds. The Pt/GaAs interfacial reactions observed by other investigators are discussed and explained in terms of the bulk phase diagram determined in this study. GRA

**N89-14888#** Ceramic Process Systems Corp., Cambridge, MA.
**COMPOSITE CERAMIC SUPERCONDUCTING FILAMENTS FOR SUPERCONDUCTING CABLE Final Report, 15 Aug. 1987 - 30 Mar. 1988**
John W. Halloran 12 Jul. 1988 108 p
(Contract N00014-87-C-0789; ARPA Order 6214)
(AD-A198657) Avail: NTIS HC A06/MF A01 CSCL 07B

This program has established the feasibility of manufacturing composite ceramic superconducting filaments for superconducting cable, based on copper-clad YBa2Cu3O7-x ceramic powders, to render the material in the form of flexible fine diameter green fibers by dry spinning, and to rapidly sinter the fibers to produce filaments with transport Jc as high as 2800 A/sq.cm. The sintered fibers can be handled, and the feasibility of cladding these fibers with copper by electrodeposition has been supported. The fibers are spun from a suspension of powder in a mixture of solvents containing several acrylic polymers, a plasticizer, a cross-linking agent, and a dispersant. The dry green fiber is a flexible monofilament containing 49 to 55 volume percent (85 to 87 weight percent) ceramic powder in a polymeric matrix. A multiple zone sintering process was developed to rapidly densify the YBa2Cu3O7-x fibers. GRA

**N89-14889#** Technische Hogeschool, Eindhoven (Netherlands).
**A SPECTROSCOPIC CHARACTERIZATION OF THE STRUCTURE OF SUPPORTED METAL CATALYSTS Ph.D. Thesis**
Johannes Hubertus An Martens 1988 251 p Sponsored by the Netherlands Foundation for Chemical Research, The Netherlands and the Netherlands Organization for the Advancement of Pure Research
(B8811777; ETN-89-93345) Avail: NTIS HC A12/MF A01

The preparation of supported metal catalysts and the reduction process in which the inactive metal salts are reduced to active metal particles are studied. The presence of ferric ions in reduced SiO2 supported bimetallic catalysts was investigated with Mossbauer spectroscopy. Alumina supported rhodium catalysts were studied by spectroscopy under oxygen at different temperatures. The results are variable, and indications of coverage are found. The results suggest that at lower temperatures coverage is only loose and could not be detected. Upon reduction at higher temperatures, the loose covering oxide may reorganize into epitaxially grown suboxide. ESA

**N89-14890#** Technische Hogeschool, Delft (Netherlands).
**OFFSET REDUCTION AND THREE DIMENSIONAL FIELD SENSING WITH MAGNETOTRANSISTORS Ph.D. Thesis**
Srdjan Kordic 1987 235 p
(ETN-89-93349) Avail: NTIS HC A11/MF A01

Causes for offsets in magnetotransistors, Hall effect plates, and several other types of device are analyzed, concluding that the main cause is the misalignment of the current source with respect to the collectors of the device. Other cause found is the piezoresistance effect in Hall devices, making the offset stress dependent. Sensitivity variation offset reduction is proposed as a method to deal with offset. Implementations of devices including offset compensation circuitry were successfully carried out. Devices sensitive to all three components of the magnetic field are also presented. ESA

**N89-14343*#** Massachusetts Inst. of Tech., Cambridge.
**MONOLITHIC TWO-DIMENSIONAL SURFACE-EMITTING ARRAYS OF GaAs/AlGaAs DIODE LASERS**
*In its* Solid State Research 11 Mar. 1988 p 1-11 (For primary document see N89-14342 06-31)
Avail: NTIS HC A04/MF A01 CSCL 13B

**N89-14347*#** Massachusetts Inst. of Tech., Cambridge.
**RF SURFACE RESISTANCE OF YBa2Cu3O(7-x) THIN FILMS**
*In its* Solid State Research 11 Mar. 1988 p 45-55 (For primary document see N89-14342 06-31)
Avail: NTIS HC A04/MF A01 CSCL 13B

**N89-14900*#** Christopher Newport Coll., Newport News, VA. Dept. of Physics.
**EFFECTS OF ELECTRON IRRADIATION ON HIGH TEMPERATURE SUPERCONDUCTORS AND CONTACTS TO HIGH TEMPERATURE SUPERCONDUCTORS Abstract Only**
Randall Caton *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 46-47 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20L

**N89-14903*#** Boston Coll., Chestnut Hill, MA. Dept. of Physics.
**SPECTROSCOPIC INVESTIGATION OF THE Cr TO Tm ENERGY TRANSFER IN YTTRIUM ALUMINUM GARNET (YAG) CRYSTALS Abstract Only**
B. DiBartolo *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 51-52 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20L

**N89-15018*#** Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
**EXPERIMENTAL STUDIES OF CRYSTAL-MELT DIFFERENTIATION IN PLANETARY BASALT COMPOSITIONS**
T. L. Grove *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 20L

# 77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

**N89-14891#** Syracuse Univ., N. Y. Dept. of Physics.
**RESEARCH PROGRAM IN ELEMENTARY PARTICLE THEORY Progress Report, period ending 31 Dec. 1988**
1988 50 p
(Contract DE-FG02-85ER-40231)
(DE88-017241; DOE/ER-40231/T4) Avail: NTIS HC A03/MF A01

The Syracuse High Energy Theory group has continued to make significant contributions to many areas. Many novel aspects of the chiral soliton description of baryons were investigated. Unified and Grand Unified Models of Particle Interactions were studied in depth. Various interesting aspects of string theory, gravity and higher dimensions were explored. This paper reviews these topics. DOE

**N89-14892#** Los Alamos National Lab., NM. Physics Div.
**FALLING ANTIMATTER: AN EXPERIMENT TO MEASURE THE GRAVITATIONAL ACCELERATION OF THE ANTIPROTON**
P. Dyer, J. Camp, M. H. Holzscheiter, and S. Graessle (Rice Univ., Houston, Tex.) 1988 15 p Presented at the International Conference on the Application of Accelerators in Research and Industry, Denton, TX, 7 Nov. 1988
(Contract W-7405-eng-36)
(DE89-000313; LA-UR-88-3193; CONF-881151-4) Avail: NTIS HC A03/MF A01

According to some theories of gravity, antimatter will fall faster than matter in the earth's gravitational field. An experiment to measure the gravitational force on the antiproton is under construction. Antiprotons of a few MeV from the LEAR facility of CERN will be slowed down and caught in a large Penning electromagnetic trap. They will then be cooled and transferred to Penning cooling and launching traps. The gravitational acceleration will be measured by the time-of-flight in a drift tube shielding stray electronic fields, and will be compared with that measured for H negative ions. Progress on a number of fronts is described. DOE

**N89-14893#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
**ON A SOLUTION OF THE EINSTEIN GRAVITATION EQUATION FOR DUST MATTER**
A. G. Bonch-Osmolovskij 1987 11 p In RUSSIAN; ENGLISH summary
(DE88-703739; JINR-R-2-87-819) Avail: NTIS (US Sales Only) HC A03/MF A01

Exact analytical solution for the Einstein equations for dust has been obtained and investigated. The main results are as follows: the model described homogeneous and isotopic Universe which expands without restriction at lambda greater than 0 and oscillates at lambda less than 0; evaluation for negative lambda and Universe's oscillations period is the absolute value of lambda and approx. = 10 sup -56 sq/cm, T approx. = 3x10 sup 10 years; near singularities the density of matter changes according

to the universal law: rho approx. (r-r sub c) sup -2, r sub c is the proper time momentum corresponding to the singularity. Possible consequences of this fact are discussed. DOE

**N89-14894#** State Univ. of New York, Buffalo. Dept. of Chemistry.
**DYNAMICS OF OBSERVED REALITY: ABRIDGED VERSION OF CLASSICAL AND QUANTUM MECHANICS**
Azizul Haque and Thomas F. George Aug. 1988 21 p
(Contract N00014-86-K-0043)
(AD-A198637; UBUFFALO/DC/88/TR-81) Avail: NTIS HC A03/MF A01 CSCL 20J

The present paper is concerned with a unified description of classical and quantum physics. A different way of thinking about the quantum world is expounded, which already has led to significant results in statistical mechanics and holds future promise for quantum mechanics. An explanation is provided for the original motivation in quantum theory, the formalisms that have evolved from it, and their differences with the classical theories. The conceptual difficulty that permeates our view of the microscopic world is spelled out and a remedy thereof suggested. GRA

# 80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

**N89-14895*#** National Aeronautics and Space Administration, Washington, DC.
**SOCIAL SCIENCES AND SPACE EXPLORATION**
1988 150 p Original doc. contains color illustrations
(EP-192) Avail: SOD HC $5.00 as 033-000-00926-7 CSCL 05K

The relationship between technology and society is a subject of continuing interest, because technological change and its effects confront and challenge society. College students are especially interested in technological change, knowing that they must cope with the pervasive and escalating effect of wide-ranging technological change. The space shuttle represents a technological change. The book's role is to serve as a resource for college faculty and students who are or will be interested in the social science implications of space technology. The book is desinged to provide introductory material on a variety of space social topics to help faculty and students pursue teaching, learning, and research. Space technologies, perspectives on individual disciplines (economics, history, international law, philosophy, political science, psychology, and sociology) and interdiscipline approaches are presented. B.G.

**N89-14896*#** Hampton Inst., VA.
**NASA/AMERICAN SOCIETY FOR ENGINEERING EDUCATION (ASEE) SUMMER FACULTY FELLOWSHIP PROGRAM 1988**
John H. Spencer, comp. Sep. 1988 129 p Program held in Hampton, VA, 6 Jun. - 12 Aug. 1988
(Grant NGT-47-020-800)
(NASA-CR-181724; NAS 1.26:181724) Avail: NTIS HC A07/MF A01 CSCL 05I

Abstracts of research conducted as part of the 1988 Hampton University - NASA - Langley Research Center Summer Faculty Fellowship Research Program are given. For individual titles, see N89-14897 through N89-14932.

**N89-14897*#** College of William and Mary, Williamsburg, VA. Dept. of Mathematics.
**OPTIMIZATION OF SLENDER WINGS FOR CENTER-OF-PRESSURE SHIFT DUE TO CHANGE IN MACH NUMBER Abstract Only** **c02**
Carl M. Andersen *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 36-37 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 01A

It is observed that the center of pressure on a wing shifts as the Mach number is changed. Such shifts are in general undesirable and are sometimes compensated for by actively shifting the center of gravity of the aircraft or by using active stability controls. To avoid this complication, it is desirable to design the wings of a high speed aircraft so as to minimize the extent of the center-of-pressure shifts. This, together with a desire to minimize the center-of-pressure shifts in missile control surfaces, provides the motivation for this project. There are many design parameters which affect center-of-pressure shifts, but it is expected that the largest effects are due to the wing planform. Thus, for the sake of simplicity, this study is confined to an investigation of thin, flat, (i.e., no camber or twist), relatively slender, pointed wings flying at a small angle of attack. Once the dependence of the center of pressure on planform and Mach number is understood, we can expect to investigate the sensitivity of the center-of-pressure shifts to various other parameters. Author

**N89-14898*#** Jackson State Univ., MS.MS. Dept. of Technology.
**END-EFFECTOR - JOINT CONJUGATES FOR ROBOTIC ASSEMBLY OF LARGE TRUSS STRUCTURES IN SPACE: A SECOND GENERATION Abstract Only** **c18**
W. V. Brewer *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 38-43 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 22B

Current designs, a first generation intended for robotic assembly, have given priority to the ease and certainty of the assembly process under less than ideal conditions with a minimum of sensory feedback. As a consequence they are either heavy or expensive and all exhibit a relatively low packaging density. Low packaging density is caused by extensive scars applied to the node, increasing its envelope diameter by as much as 150 percent. Strut envelopes are violated to a lessor extent with diameters increased by 25 percent or more. This smaller percentage is still a significant problem owing to a much higher fraction of the packaged volume represented by struts. As structures in space become larger, packaging density becomes an important consideration. The objective is to develop end-effector-joint conjugates that do not violate the envelopes of a 2.5 inch diameter node or a 1.0 inch diameter strut. Author

**N89-14899*#** State Univ. of New York, Brockport. Dept. of the Earth Sciences.
**USE OF THE TERMINAL AREA SIMULATION SYSTEM (TASS) TO STUDY MICROBURST WIND SHEARS** **c47**
Gregory P. Byrd *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 44-45 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 04B

Ground-based and airborne Doppler radar and LIDAR systems are being designed to alert pilots when a hazardous windshear is present. A key element in this design effort is understanding the microburst itself. This is accomplished by means of the TASS model which was developed for NASA by Proctor (1987a,b). The time-dependent TASS model has two vesions: a two-demensional high resolution axisymmetric model, and a three-demensional model. The model includes a sophisticated parameterization of cloud microphysics and a friction layer, both of which are essential to a realistic simulation of the microburst phenomenon. The TASS model has been successfully tested on well-observed convective events. Author

**N89-14900*#** Christopher Newport Coll., Newport News, VA. Dept. of Physics.
**EFFECTS OF ELECTRON IRRADIATION ON HIGH TEMPERATURE SUPERCONDUCTORS AND CONTACTS TO HIGH TEMPERATURE SUPERCONDUCTORS Abstract Only** **c76**
Randall Caton *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program

1988 p 46-47 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20L

The discovery of a new class of ceramic superconductors with transition temperatures above liquid nitrogen has opened the doors for exciting space applications. Energy storage, pointing maneuvers, magnetic shielding, and sensitive detection of electromagnetic radiation are some of the longer term possible applications. One near term application involves low electrical resistance, high thermal resistance connections between a detector operating at approximatly or equal to 4 and the electronics operating at approximatly or equal to 77 K. The new high temperature superconductors could accomplish this providing the necessary electrical connections to the ground plane while isolating the system thermally, thus prolonging the life of the mission. With such possibilities it is clearly of value to study the effects of radiation that would be experienced during a typical space mission. In this work we focused specifically on the effects of the electron radiation environment. Author

**N89-14901*#** Lowell Univ., MA. Dept. of Mechanical and Energy Engineering.
**SOME TEST/ANALYSIS ISSUES FOR THE SPACE STATION STRUCTURAL CHARACTERIZATION EXPERIMENT Abstract Only** **c18**
Chaur-Ming Chou *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 48-49 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 22B

The Space Station Structural Characterization Experiment (SSSCE) 1,2 is an early space flight experiment that uses the space station as a generic structure to study the dynamic characteristics of Large Space Structures (LSS). On-orbit modal testing will be conducted to determine natural frequencies, mode shapes and damping of dominant structural modes of the space structure assembly. This experiment will utimately support the development of system indentification and analytical modeling techniques for Large Space Structures. In order to ensure the success of SSSCE (in-space validation of modeling techniques for LSS), adequate measurement and instrumentation requirements have to be established during the experiment-definition study. Among the issues affecting these requirements, spatial and modal coverages of the modal test data are of particular interest. Topics such as total number of sensors, type of measurements (translation and rotation), optimal sensor locations (measurement degrees-of-freedom), selection of target modes, effects of modal superposition and truncation, separation of global and local modes, etc., are all a fundamental importance and must be investigated. Author

**N89-14902*#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace Engineering.
**CONTROL OF THE FLEXIBLE MODES OF AN ADVANCED TECHNOLOGY GEOSTATIONARY PLATFORM Abstract Only** **c18**
Diane V. DeWalt *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 50 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 22B

A controls analysis is conducted on an advanced technology geostationary platform. This spacecraft is a large flexible structure with a payload of Earth-sensing instruments which will collect data from Earth's oceans, land, and atmosphere as a part of the bold initiative mission to Planet Earth proposed by NASA. This program will provide a collection of data from a family of spacecraft in both low-Earth orbit and geostationary orbit, which will afford a global definition of the Earth as a system with the capability to predict future events resulting from human and natural forces. The platform concept studied here is a large flexible structure with a payload of eighteen instruments. Because the platform is in geostationary orbit, these instruments have sensitive pointing accuracy requirements, in the range of 0.1 to 0.0001 degrees, which must be satisfied. The structure housing the instruments is large and flexible with characteristic low natural frequencies, so active control is necessary for vibration suppression. Author

**N89-14903*#** Boston Coll., Chestnut Hill, MA. Dept. of Physics.
**SPECTROSCOPIC INVESTIGATION OF THE Cr TO Tm ENERGY TRANSFER IN YTTRIUM ALUMINUM GARNET (YAG) CRYSTALS Abstract Only** **c76**
B. DiBartolo *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 51-52 (For primary document see N89-14896 06-80)
Avail: NTIS HC 07/MF A01 CSCL 20L

New and interesting schemes have recently been considered for the efficient operation of solid-state ionic laser systems. Often the available data on these systems were obtained only because they seemed directly related to the laser performance and provide no insight into the physical processes. A more systematic approach is desirable, where more attention is devoted to the elementary basic processes and to the nature of the mechanisms at work. It is with this aim that we have undertaken the present study. Yttrium Aluminum Garnet (Y4Al5O12), called YAG, has two desirable properties as host for rare earth impurities: (1) trivalent rare earth ions can replace the yttrium without any charge compensation problem, and (2) YAG crystals have high cutoff energies. The results of measurements and calculations indicate that the Cr(3+) ion in YAG can be used to sensitize efficiently the Tm(3+) ion. Author

**N89-14904*#** Morgan State Univ., Baltimore, MD. Dept. of Comprehensive Science and Science Education.
**THE EFFECTS OF BIOMASS BURNING ON THE CONCENTRATION OF TRACE GASES IN THE ATMOSPHERE Abstract Only** **c45**
Leon M. Donaldson *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 53-54 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 13B

Over the past several years, there has been considerable interest concerning the global effects of biomass burning on concentrations of trace gases in the atmosphere. The paucity of reported studies and investigations into the effects of the Greenhouse Gases such as carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O), up until about a decade ago, would suggest that the topic was not then one of universal concern. Efforts are now being made to understand the biogenic, anthropogenic and photochemical sources of atmospheric trace gases. Biomass burning which includes the burning of forests for clearing, the burning of vegetative stubble after harvesting, and lightning and human-induced wildfires is but one consideration under the general paradigm of atmospheric perturbations. A team of researchers from the Langley Research Center, along with the Canadian Forest Ministry, Ontario, Canada collaborated in an experiment in a deforestration effort through a prescribed burn. Through a specially designed experimental modeling and instrumentation, a substantial pre-burn data set was collected. The primary focus of the pre-burn experimental activities was the emission of nitrous oxide (N2O) gas from selected sites. Author

**N89-14905*#** Valparaiso Univ., Ind. Dept. of Mechanical Engineering.
**AN INVESTIGATION OF TURBULENCE MODELS Abstract Only** **c34**
Michael L. Doria *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 55-56 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 20D

The accuracy to which a turbulent boundary layer or wake

can be predicted numerically depends on the validity of the turbulence closure model used. The modeling of turbulence physics is one of the most difficult problems in computational fluid dynamics (CFD). In fact, it is one of the pacing factors in the development of CFD. In general, there are three main approaches to the description of trubulence physics. First is turbulence modeling in which the Reynolds averaged Navier-Stokes equations are used and some closure approximation is made for the Reynolds stresses. A second approach to turbulence is large eddy simulation (LES) in which the computational mesh is taken to be fine enough that the large scale structure of the turbulence can be calculated directly. An empirical assumption must be made for the small scale sub-grid turbulence. The third approach is direct simulation. In this technique the Navier-Strokes equations are solved directly on a mesh which if fine enough to resolve the smallest length scale of the turbulence. The Reynolds averaged equations are not used and no closure assumption is required. These last two approaches require extensive computer resources and as such are not engineering tools. The purpose of the work was to investigate the various engineering turbulence models for accuracy and ease of programming. This involved comparison of the models with each other and with experimental data. Author

**N89-14906*#** Hampton Inst., VA.
**MODIFYING PASVART TO SOLVE SINGULAR NONLINEAR 2-POINT BOUNDARY PROBLEMS Abstract Only c64**
James P. Fulton *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 57-58 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 12A

To study the buckling and post-buckling behavior of shells and various other structures, one must solve a nonlinear 2-point boundary problem. Since closed-form analytic solutions for such problems are virtually nonexistent, numerical approximations are inevitable. This makes the availability of accurate and reliable software indispensable. In a series of papers Lentini and Pereyra, expanding on the work of Keller, developed PASVART: an adaptive finite difference solver for nonlinear 2-point boundary problems. While the program does produce extremely accurate solutions with great efficiency, it is hindered by a major limitation. PASVART will only locate isolated solutions of the problem. In buckling problems, the solution set is not unique. It will contain singular or bifurcation points, where different branches of the solution set may intersect. Thus, PASVART is useless precisely when the problem becomes interesting. To resolve this deficiency we propose a modification of PASVART that will enable the user to perform a more complete bifurcation analysis. PASVART would be combined with the Thurston bifurcation solution: as adaptation of Newton's method that was motivated by the work of Koiter 3 are reinterpreted in terms of an iterative computational method by Thurston. Author

**N89-14907*#** Arizona Univ., Tucson. Dept. of Nuclear and Energy Engineering.
**BENCHMARK SOLUTIONS FOR THE GALACTIC ION TRANSPORT EQUATIONS WITH SPATIAL AND ENERGY COUPLING Abstract Only c93**
Barry D. Ganapol *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 59-60 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 03B

In order to anticipate future space shielding requirements, NASA has initiated an effort to formulate computational methods to simulate radiation effects in space. As part of the program, numerical transport algorithms have been developed for the deterministic Boltzman equation describing galactic cosmic ray (GCR) interactions with matter. It thus becomes necessary to assess the accuracy of proposed deterministic algorithms. For this reason, analytical benchmark solutions to mathematically tractable galactic cosmic ray equations have recently been obtained. Even though these problems involve simplifying assumptions of the associated physics, they still contain the essential features of the basic transport processes. The solutions obtained are features of the basic transport processes. The solutions obtained are compared to results from numerical algorithms in order to ensure proper coding and to provide a measure of the accuracy of the numerical methods used in the algorithm. For the first time, mathematical methods have been applied to the galactic ion transport (GIT) equations in the straight ahead approximation with constant nuclear properties. The approach utilizes a Laplace transforms inversion yielding a closed form benchmark solution which is also computationally efficient. Author

**N89-14908*#** Hampton Inst., VA. Dept. of Middle and Secondary Education.
**CURRICULUM IN AEROSPACE SCIENCE AND TECHNOLOGY IN COOPERATION WITH NASA LANGLEY RESEARCH CENTER Abstract Only**
Cathine Garner-Gilchrist *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 61-62 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 05I

A curriculum was written to show teachers how to best use the many resources that are available at the Teacher Resource Center (TRC). This curriculum packet was written using teaching units that teachers in both the elementary and middle schools can use to help students better understand some of the research that has been conducted at NASA and will be conducted in the future. The units are written with certain standards. Each unit contains: (1) specific objectives, using the Virginia standards of learning; (2) the materials that are available from the TRC; (3) many activities that teachers can use in a variety of ways; and (4) specific strategies for measuring the objectives to determine if the students mastered the knowledge, concepts or skills that were taught. The curriculum packet contains specific units on several topics. They are: (1) Careers in Aerospece Science and Technology; (2) The History of Flight; (3) The History of Satellites; (4) The History of the Manned Space Projects and the Future of the Future of the Space Program; (5) The Solar System; and (6) The History of Rockets. Author

**N89-14909*#** Washington Univ., Seattle. Dept. of Aeronautics and Astronautics.
**APPROACHES TO NON-LINEAR AERODYNAMIC ANALYSIS AND DESIGN Abstract Only c02**
Louis B. Gratzer *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 63-64 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 01A

Within the last two decades, there has been increasing emphasis on developing more sophisticated computational fluid dynamics (CFD) methods to handle a wide range of problems of interest to the aerospace community. The comprehensive picture of the status of CFD development and capability as well as an assessment of requirements and future directions are given. An independent review and assessment was also carried out by the author as part of the current assignment and the results are outlined herein. Author

**N89-14910*#** Bethune-Cookman Coll., Daytona Beach, FL. Div. of Science and Mathematics.
**COMPUTER MODELING OF POLYMERS Abstract Only c27**
Terry J. Green *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 65-66 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11C

A Polymer Molecular Analysis Display System (p-MADS) was developed for computer modeling of polymers. This method of modeling allows for the theoretical calculation of molecular properties such as equilibrium geometries, conformational energies, heats of formations, crystal packing arrangements, and other

properties. Furthermore, p-MADS has the following capabilities: constructing molecules from internal coordinates (bonds length, angles, and dihedral angles), Cartesian coordinates (such as X-ray structures), or from stick drawings; manipulating molecules using graphics and making hard copy representation of the molecules on a graphics printer; and performing geometry optimization calculations on molecules using the methods of molecular mechanics or molecular orbital theory. Author

**N89-14911*#** Eureka Coll., IL. Math and Physics.
**LASER CLOCKS AND NEAR FIELD GRAVITY OF ROTATING OBJECTS Abstract Only** **c70**
Joseph C. Hafele *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 67-69 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 20C

This work explores the feasibliity of using high performance laser clocks to detect effects of rotation in the near field region of the Earth's gravitational field. According to general relativity, the time recorded by an independent clock is the proper time of the space-time metric that applies to the system under consideration. If the gravitational source is stationary (nonrotating), proper time involves only the speed of the clocks and the scalar gravitational potential at the position of the clocks. However, if the source is rotating, the motion of the source could have an effect on the metric. Previous attempts to calculate the relativistic timekeeping for terrestrial clocks have used the metric for a nonrotating system, primarily because metrics for a rotating system were not available. This work investigates the specific effects of rotation on the Earth's gravitational field and the corresponding effect on timekeeping of laser clocks in the near field environment. Author

**N89-14912*#** Tennessee Univ., Knoxville. Dept. of Chemical Engineering.
**SEMI-INTERPENETRATING POLYMER NETWORK'S OF POLYIMIDES: FRACTURE TOUGHNESS Abstract Only** **c27**
Marion Glenn Hansen *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 70 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11C

The objective was to improve the fracture toughness of the PMR-15 thermosetting polyimide by co-disolving LaRC-TPI, a thermoplastic polyimide. The co-solvation of a thermoplastic into a thermoset produces an interpenetration of the thermoplastic polymer into the thermoset polyimide network. A second research program was planned around the concept that to improve the fracture toughness of a thermoset polyimide polymer, the molecular weight between crosslink points would be an important macromolecular topological parameter in producing a fracture toughened semi-IPN polyimide. Author

**N89-14913*#** Missouri Univ., Rolla. Dept. of Aerospace Engineering.
**MODELING OF HYDROGEN-AIR DIFFUSION FLAME Abstract Only** **c25**
Kakkattukuzhy Isaac *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 71 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 21B

The present research objective is to determine the effects of contaminants on extinction limits of simple, well defined, counterflow Hydrogen 2-air diffusion flames, with combustion at 1 atmosphere. Results of extinction studies and other flame characterizations, with appropriate mechanistic modeling (presently underway), will be used to rationalize the observed effects of contamination over a reasonably wide range of diffusion flame conditions. The knowledge gained should help efforts to anticipate the effects of contaminants on combustion processes in Hydrogen 2-fueled scramjets. Author

**N89-14914*#** College of William and Mary, Williamsburg, VA. Dept. of Chemistry.
**RADIATION EFFECTS ON POLYMERIC MATERIALS Abstract Only** **c27**
Richard L. Kiefer *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 72-74 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11C

It is important to study changes in properties of polymeres after irradiation with charged particles, with ultraviolet radiation, and with combinations of both. An apparatus for this purpose has been built at the NASA Langley Research Center. It consists of a chamber 9 inches in diameter and 9 inches high with a port for an electron gun, another port for a mass spectrometer, and a quartz window through which an ultraviolet lamp can be focused. The chamber, including the electron gun and the mass spectrometer, can be evacuated to a pressure of 10 to the 8th power torr. A sample placed in the chamber can be irradiated with electrons and ultraviolet radiation separately, sequentially, or simultaneously, while volatile products can be monitored during all irradiations with the mass spectrometer. The apparatus described above has been used to study three different polymer films: lexan; a polycarbonate; P1700, a polysulfone; and mylar, a polyethylene terephthalate. All three polymers had been studied extensively with both electrons and ultraviolet radiation separately, but not simultaneously. Also, volatile products had not been monitored during irradiation for the materials. A high electron dose rate of 530 Mrads/hr was used so that a sufficient concentration of volatile products would be formed to yield a reasonable mass spectrum. Author

**N89-14915*#** Elizabeth City State Univ., NC. Dept. of Physical Sciences.
**THE DETERMINATION OF ENERGY TRANSFER RATES IN THE Ho:Tm:Cr:YAG LASER MATERIAL Abstract Only** **c36**
Edmond B. Koker *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 75-77 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 20E

Energy transfer processes occurring between atomic, ionic, or molecular systems are very widespread in nature. The applications of such processes range form radiation physics and chemistry to biology. In the field of laser physics, energy transfer processes have been used to extend the lasing range, increase the output efficiency, and influence the spectral and temporal characteristics of the output pulses of energy transfer dye lasers or solid-state laser materials. Thus in the development of solid state lasers, it is important to investigate the basic energy transfer (ET) mechanisms and processes in order to gain detailed knowledge so that successful technical utilization can be achieved. The aim of the present research is to measure the ET rate from a given manifold associated with the chromium sensitizer atom to a given manifold in the holmium activator atom via the thulium transfer atom, in the Ho:Cr:YAG laser material. Author

**N89-14916*#** Puerto Rico Univ., Mayaguez. Dept. of Mechanical Engineering.
**TRANSIENT HEAT TRANSFER FROM SHRINKING LOX-DROP Abstract Only** **c34**
Nenad N. Kondic *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 78-80 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 20D

In order to achieve prescribed experimental conditions in wind

tunnels, the nitrogen-oxygen mixture is enriched by injection of liquid oxygen (LOX) upstream of methane burners. The objective of the study is to determine the LOX drop evaporation rate, which is dominated by heat transfer from the air stream (mass transfer mechanism can be later coupled with the solution from the present work). Since the concentration of drops in the surrounding gas is quite high, the concept of infinite medium cannot be utilized. Drop evaporation, as part of system's mass balance, is an important source-term in the finite-difference 2/3-dimensional network terms of laboratory-system (Eulerian) coordinates, while individual drop behavior, including its thermal history, is analyzed in Lagrangian coordinates. Author

**N89-14917*#** Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
**MODELING OF TRANSITIONAL FLOWS Abstract Only c34**
Thomas S. Lund *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 81-83 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 20D

An effort directed at developing improved transitional models was initiated. The focus of this work was concentrated on the critical assessment of a popular existing transitional model developed by McDonald and Fish in 1972. The objective of this effort was to identify the shortcomings of the McDonald-Fish model and to use the insights gained to suggest modifications or alterations of the basic model. In order to evaluate the transitional model, a compressible boundary layer code was required. Accordingly, a two-dimensional compressible boundary layer code was developed. The program was based on a three-point fully implicit finite difference algorithm where the equations were solved in an uncoupled manner with second order extrapolation used to evaluate the non-linear coefficients. Iteration was offered as an option if the extrapolation error could not be tolerated. The differencing scheme was arranged to be second order in both spatial directions on an arbitrarily stretched mesh. A variety of boundary condition options were implemented including specification of an external pressure gradient, specification of a wall temperature distribution, and specification of an external temperature distribution. Overall the results of the initial phase of this work indicate that the McDonald-Fish model does a poor job at predicting the details of the turbulent flow structure during the transition region. Author

**N89-14918*#** Mississippi State Univ., Mississippi State. Dept. of Mathematics and Statistics.
**OVERLAPPING GRIDS FOR FLOW FIELD CALCULATIONS Abstract Only c34**
Charles Wayne Mastin *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 84-85 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 20D

Many problems in computational fluid dynamics (CFD) involve the calculation of flow fields within or around complex geometric configurations. The flow solution is computed on a computational grid. The construction of the grid is one of the major difficulties in the application of CFD to the analysis of flow about actual aircraft configurations. Due to geometric complexity, the grid has to be constructed in simple subregions and then all of these subgrids have to be pieced together to form a complete grid for the entire flow field. The entire grid, which is called a composite grid because it is formed from many parts, may have common regions. In either case, the computation of the flow field, using any numerical algorithm, will require the transfer of information between individual subgrids. The transfer of information is more difficult with overlapping grids. Algorithms have been developed and tested for automating the transfer of information between two overlapping grids. Author

**N89-14919*#** California Univ., Berkeley. Dept. of Mechanical Engineering.
**EQUIVALENT LINEARIZATION FOR FATIGUE LIFE ESTIMATES OF A NONLINEAR STRUCTURE Abstract Only c38**
R. N. Miles *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 86 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 14D

An adaptation of the method of equivalent linearization is developed in order to estimate the fatigue life of a nonlinear structure excited by Gaussian white noise. While conventional equivalent linearization has been successfully applied to approximate the mean square responses of the variety of complex nonlinear systems, it has not been possible to apply the method for fatigue predictions. This limitation results from the assumption that the probability density of the response of the nonlinear system is Gaussian, which is not generally true. In the present effort, a modification of equivalent linearization, developed by the author, is employed which has been shown in recent studies to provide a much more accurate description of the random response of a nonlinear structure than provided by conventional equivalent linearization. A method is presented for estimating fatigue life based on this approach and results are compared with those obtained using both numerical simulation and the classical method. The fatigue life is estimated for a nonlinear plate vibrating in a single resonant mode with random white noise excitation. Excellent agreement is found between all three methods. These results indicate that equivalent linearization may be extended to predict the fatigue life of more complex nonlinear systems than can be analyzed at present. Author

**N89-14920*#** Hampton Inst., VA. Airway Science Program.
**EVALUATION OF THE PSEUDO PILOT EFFECT ON BASELINE CONTROLLER STUDY DATA Abstract Only c54**
Linda C. Newcomb *In its* NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program Sep. 1988 p 87 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 05H

The Baseline Controller Study requires the support of pseudo pilots who input computer commands in response to air data in a simulated environment. Errors committed either by pseudo pilots, or by the computer's failure to accept commands, can result in data that is not representative of controller capabilities. Therefore, it became necessary to evaluate the actions of the pseudo pilots and determine what effect, if any, those actions had upon a given set of baseline data. The Pseudo Pilot Stations (PPS) associated with the Baseline Controller Study are user unfriendly. This fact, coupled with the human factor of the pilots themselves, required exploration of the degree the pseudo pilot's actions affected the subject air traffic controller actions during the collection of baseline data. Examination of the preliminary data collected by the Basline Controller Study subjectively determined that pseudo pilot actions do, indeed, affect the the research data. Further study is needed to quantify that affect and, perhaps, assign a value to the pseudo pilot factor rather than merely decide which simulations are valid and which are not. Author

**N89-14921*#** College of William and Mary, Williamsburg, VA. Dept. of Chemistry.
**THE EFFECTS OF ATOMIC OXYGEN ON POLYMERIC MATERIALS Abstract Only c27**
Robert A. Orwoll *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 88-89 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11C

At the altitudes of low-earth orbit (LEO), atomic oxygen (AO) is the most abundant chemical species. This strong oxidizing agent reacts with virtually any organic material that is not already fully oxidized. Erosion by AO can be extensive and jeopardizes any

protective coatings, thermal blankets, adhesives, and structural composites exposed on the exterior of satellites in LEO. Researchers prepared and tested organic materials for their susceptibility to AO using a commercial plasma asher which approximately simulates the oxygen effects in LEO. Experiments were performed on a polyimide, a polysulfone, and two epoxy adhesives into which low molecular-weight additives have been dissolved. Incorporated in the molecular structure of these additives are elements such as silicon whose nonvolatile oxides, which are formed on exposure to AO, remain as a coating on the surface to create a barrier between the remainder of the organic material and the AO. We find that the additives protect the materials, but the low solubility of some limit their utility. Concurrent studies are underway to measure the effect of the additives on the thermal expansion coefficients of the materials. Tows of aramid fibers, which are important components in the proposed tether satellite systems, have been eroded in the asher. The results which show that the square root of the mass remaining decreases linearly with the time of exposure (see the figure) are consistent with a constant rate of surface erosion. The tensile strength of these eroded tows decreases with time of exposure also; additional measurements are in progress. Author

**N89-14922*#** Oklahoma Univ., Norman. Dept. of Aerospace and Mechanical Engineering.

**THE POSTSTALL NONLINEAR DYNAMICS AND CONTROL OF AN F-18: A PRELIMINARY INVESTIGATION Abstract Only** **c05**

William N. Patten *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 90-92 (For primary document see N89-14896 06-80)

Avail: NTIS HC A07/MF A01 CSCL 01C

The successful high angle of attack (HAOA) operation of fighter aircraft will necessarily require the introduction of a new onboard control methodology that address the nonlinearity of the system when flown at the stall/poststall limits of the craft's flight envelope. As a precursor to this task, a researcher endeavored to familarize himself with the dynamics of one specific aircraft, the F-18, when it is flown at HAOA. This was accomplished by conducting a number of real time flight sorties using the NASA-Langley Research Center's F-18 simulator, which was operated with a pilot in the loop. In addition to developing a first hand familarity with the aircraft's dynamic characteristic at HAOA, work was also performed to identify the input/output operational footprint of the F-18's control surfaces. This investigator proposes to employ the nonlinear models of the plant identified this summer in a subsequent research effort that will make it possible to fly the F-18 effectively at poststall angles of attack. The controller design used there will rely on a new technique proposed by this investigator that provides for the automatic generation of online optimal control solutions for nonlinear dynamic systems. Author

**N89-14923*#** College of William and Mary, Williamsburg, VA. Dept. of Mathematics.

**GENERALIZED EIGENVALUES FOR PAIRS ON HERITIAN MATRICES Abstract Only** **c64**

George Rublein *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 93 (For primary document see N89-14896 06-80)

Avail: NTIS HC A07/MF A01 CSCL 12A

A study was made of certain special cases of a generalized eigenvalue problem. Let A and B be nxn matrics. One may construct a certain polynomial, P(A,B, lambda) which specializes to the characteristic polynomial of B when A equals I. In particular, when B is hermitian, that characteristic polynomial, P(I,B, lambda) has real roots, and one can ask: are the roots of P(A,B, lambda) real when B is hermitian. We consider the case where A is positive definite and show that when N equals 3, the roots are indeed real. The basic tools needed in the proof are Shur's theorem on majorization for eigenvalues of hermitian matrices and the interlacing theorem for the eigenvalues of a positive definite hermitian matrix and one of its principal (n-1)x(n-1) minors. The method of proof first reduces the general problem to one where the diagonal of B has a certain structure: either diag (B) = diag (1,1,1) or diag (1,1,-1), or else the 2 x 2 principal minors of B are all 1. According as B has one of these three structures, we use an appropriate method to replace A by a positive diagonal matrix. Since it can be easily verified that P(D,B, lambda) has real roots, the result follows. For other configurations of B, a scaling and a continuity argument are used to prove the result in general. Author

**N89-14924*#** Arkansas State Univ., State University. Dept. of Computer Science.

**A FLIGHT TEST DESIGN FOR STUDYING AIRBORNE APPLICATIONS OF AIR TO GROUND DUPLEX DATA LINK COMMUNICATIONS Abstract Only** **c32**

Charles H. Scanlon *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 94-96 (For primary document see N89-14896 06-80)

Avail: NTIS HC A07/MF A01 CSCL 17B

The Automatic En Route Air Traffic Control (AERA) and the Advanced Automated System (AAS) of the NAS plan, call for utilization of data links for such items as computer generated flight clearances, enroute minimum safe altitude warnings, sector probes, out of conformance check, automated flight services, and flow management of advisories. A major technical challenge remaining is the integration, flight testing, and validation of data link equipment and procedures in the aircraft cockpit. The flight test organizational chart, was designed to have the airplane side of data link experiments implemented in the NASA Langley Research Center (LaRC) experimental Boeing 737 airplane. This design would enable investigations into implementation of data link equipment and pilot interface, operations, and procedures. The illustrated ground system consists of a work station with links to a national weather database and a data link transceiver system. The data link transceiver system could be a Mode-S transponder, ACARS, AVSAT, or another type of radio system such as the military type HF data link. The airborne system was designed so that a data link transceiver, workstation, and touch panel could be interfaced with an input output processor to the aircraft system bus and thus have communications access to other digital airplane systems. Author

**N89-14925*#** Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.

**EXTENSION AND VALIDATION OF A METHOD FOR LOCATING DAMAGED MEMBERS IN LARGE SPACE TRUSSES Abstract Only** **c18**

Suzanne Weaver Smith *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 97-98 (For primary document see N89-14896 06-80)

Avail: NTIS HC A07/MF A01 CSCL 22B

The damage location approach employs the control system capabilities for the structure to test the structure and measure the dynamic response. The measurements are then used in a system identification algorithm to produce a model of the damaged structure. The model is compared to one for the undamaged structure to find regions of reduced stiffness which indicate the location of damage. Kabe's 3,4 stiffness matrix adjustment method was the central identification algorithm. The strength of his method is that, with minimal data, it preserves the representation of the physical connectivity of the structure in the resulting model of the damaged truss. However, extensive storage and computational effort were required as a result. Extension of the damage location method to overcome these problems is the first part of the current work. The central system identification algorithm is replaced with the MSMT method of stiffness matrix adjustment which was previously derived by generalizing an optimal-update secant method

form quasi-Newton approaches for nonlinear optimization. Validation of the extended damage location method is the second goal. Author

**N89-14926*#** Akron Univ., OH. Dept. of Polymer Engineering.
**POLYMER POWDER PREPREGGING: SCOPING STUDY Abstract Only** **c27**
James L. Throne *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 99-100 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11C

Early on, it was found that NEAT LARC-TPI thermoplastic polyimide powder behaved elastoplastically at pressures to 20 ksi and temperatures to 260 degrees celcius (below MP). At high resin assay, resin powder could be continuously cold-flowed around individual carbon fibers in a metal rolling mill. At low resin assay (2:1, C:TPI), fiber breakage was prohibitive. Thus, although processing of TPI below MP would be quite unique, it appears that the polymer must be melted and flowed to produce low resin assay prepreg. Fiber tow was spread to 75 mm using a venturi slot tunnel. This allowed intimate powder/fiber interaction. Two techniques were examined for getting room temperature powder onto the room temperature fiber surface. Electrostatic powder coating allows the charged powder to cling tenaciously to the fiber, even while heated with a hot air gun to above its melt temperature. A variant of the wet slurry coating process was also explored. The carbon fibers are first wetted with water. Then dry powder is sprinkled onto the wet tow and doctor-rolled between the fibers. The wet structure is then taken onto a heated roll, with hot air guns drying and sinter-melting the powder onto the fiber surfaces. In both cases SEM shows individual fibers coated with powder particles that have melted in place and flowed along the fiber surface via surface tension. Author

**N89-14927*#** Norfolk State Coll., Va. Dept. of Management.
**COMPARATIVE STUDY OF CAREER DEVELOPMENT AND TRAINING PROGRAMS Abstract Only**
Alan Tsao *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 101 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 05I

Improvement of human capital has been identified as the key to any further increase of productivity for any country engaged in the global economic competition. The same can be said of any organization seeking to enhance its overall performance. This study is aimed at: (1) surveying the current practices of career development and training programs at major corporations and government research organizations; (2) presenting the distributions of various program features among survey respondents; (3) identifying the profile of the training program of a typical research organization, against which each organization can check and identify its relative strengths as well as areas needing further strengthening; (4) conducting an economic analysis of the effectiveness of the training programs at Langley Research Center; and (5) making recommendations as to how to enhance existing training programs. Author

**N89-14928*#** Ohio State Univ., Columbus. Dept. of Mathematics.
**NUMERICAL METHODS FOR TURBULENT FLOW Abstract Only** **c34**
James C. Turner, Jr. *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 102 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 20D

It has generally become accepted that the Navier-Strokes equations predict the dynamic behavior of turbulent as well as laminar flows of a fluid at a point in space away form a discontinuity such as a shock wave. Turbulence is also closely related to the phenomena of non-uniqueness of solutions of the Navier-Strokes equations. These second order, nonlinear partial differential equations can be solved analytically for only a few simple flows. Turbulent flow fields are much to complex to lend themselves to these few analytical methods. Numerical methods, therefore, offer the only possibility of achieving a solution of turbulent flow equations. In spite of recent advances in computer technology, the direct solution, by discrete methods, of the Navier-Strokes equations for turbulent flow fields is today, and in the foreseeable future, impossible. Thus the only economically feasible way to solve practical turbulent flow problems numerically is to use statistically averaged equations governing mean-flow quantities. The objective is to study some recent developments relating to the use of numerical methods to study turbulent flow. Author

**N89-14929*#** Washington Univ., Seattle. Dept. of Mechanical Engineering.
**THE VISCOPLASTIC BEHAVIOR OF SCS6/Ti-15-3 METAL MATRIX COMPOSITE MATERIALS AT ELEVATED TEMPERATURES Abstract Only** **c24**
Mark E. Tuttle *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 103-104 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 11D

Titanium-based metal matrix composite materials (MMC'S) are being considered for use in the National Aerospace Plane. It is expected that these materials will be subjected to temperatures ranging up to about 820 C (1500 F). The present study was a preliminary investigation intended to quantify the level of viscoplastic behavior exhibited by SCS6/Ti-15-3 MMC's at elevated temperatures. The study consisted of a series of uniaxial creep/creep recovery tests. These tests were conducted in air at a temperature of 535 C (1000 F). Three distinct types of specimens were tested: Ti-15-3 heat matrix specimens (O2/plus or minus 45) sub s composite specimens, and (90 sub 2/plus or minus 45) sub s composite specimens. Tensile loads were applied to the specimens using a lever-arm creep frame equipped with a high temperature furnace. Specimen creep stains were monitored using an LVDT-based extensometer. Author

**N89-14930*#** Old Dominion Univ., Norfolk, Va. Dept. of Chemical Sciences.
**PRETREATMENT OF CO OXIDATION CATALYSTS Abstract Only** **c25**
John D. VanNorman *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 105 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 07D

CO oxidation catalysts with high activity in the range of 25 C to 100 C are important for long-life, closed-cycle operation of pulsed carbon dioxide 2 lasers. A reductive pretreatment with either CO or H sub 2 was shown to significantly enhance the activity of a commerically-available platinum on tin (IV) oxide (Pt/SnO2) catalyst relative to an oxidative or inert pretreatment or no pretreatment. Pretreatment at temperatures of 175 C and above caused an initial dip in observed CO or O sub 2 loss or CO sub 2 formation in a test gas mixture of 1 percent CO and 0.5 percent O sub 2 in a He gas matrix before a steady-state yield was obtained. This dip was found to be caused by dehydration of the surface of the catalyst and was readily eliminated by humidifying the catalyst or the test gas mixture. It was also found that too much moisture resulted in a lower overall yield of CO sub 2. Under similar conditions, it is hypothesized that the effect of the humidification is to increase the concentration of OH groups on the surface of the catalyst. The effect of having high concentration of CO sub 2 in the test gas mixture upon the loss of CO and O sub 2 as well as the effect of periods of relaxation of the catalyst under non-test gas conditions was studied. The purpose of these studies was to gain an insight into the mechanism of CO oxidation on this type of catalyst. Author

**N89-14931*#** South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Science.
**TEXTURE-BASED CLOUD CLASSIFICATION Abstract Only**
**c47**
Ronald M. Welch *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 106-107 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 04B

The purpose of the 1988 ASEE Summer Program has been to broaden the application of texture-based cloud classification approaches to lower spatial resolution GOES imagery, and to design texture-based approaches for determining cloud cover over high albedo surfaces. Author

**N89-14932*#** Ohio State Univ., Columbus. Dept. of Engineering Mechanics.
**THE INFLUENCE OF AND THE IDENTIFICATION OF NONLINEARITY IN FLEXIBLE STRUCTURES Abstract Only**
**c39**
Lawrence D. Zavodney *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 108-109 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 20K

Several models were built at NASA Langley and used to demonstrate the following nonlinear behavior: internal resonance in a free response, principal parametric resonance and subcritical instability in a cantilever beam-lumped mass structure, combination resonance in a parametrically excited flexible beam, autoparametric interaction in a two-degree-of-freedom system, instability of the linear solution, saturation of the excited mode, subharmonic bifurcation, and chaotic responses. A video tape documenting these phenomena was made. An attempt to identify a simple structure consisting of two light-weight beams and two lumped masses using the Eigensystem Realization Algorithm showed the inherent difficulty of using a linear based theory to identify a particular nonlinearity. Preliminary results show the technique requires novel interpretation, and hence may not be useful for structural modes that are coupled by a guadratic nonlinearity. A literature survey was also completed on recent work in parametrically excited nonlinear system. In summary, nonlinear systems may possess unique behaviors that require nonlinear identification techniques based on an understanding of how nonlinearity affects the dynamic response of structures. In this was, the unique behaviors of nonlinear systems may be properly identified. Moreover, more accutate quantifiable estimates can be made once the qualitative model has been determined. Author

# 81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**N89-14933*#** OAO Corp., Greenbelt, Md.
**PROMIS (PROCUREMENT MANAGEMENT INFORMATION SYSTEM) Final Report**
23 Sep. 1987 23 p
(Contract NAS8-35928)
(NASA-CR-179395; NAS 1.26:179395) Avail: NTIS HC A03/MF A01 CSCL 05A

The PROcurement Management Information System (PROMIS) provides both detailed and summary level information on all procurement actions performed within NASA's procurement offices at Marshall Space Flight Center (MSFC). It provides not only on-line access, but also schedules procurement actions, monitors their progress, and updates Forecast Award Dates. Except for a few computational routines coded in FORTRAN, the majority of the systems is coded in a high level language called NATURAL. A relational Data Base Management System called ADABAS is utilized. Certain fields, called descriptors, are set up on each file to allow the selection of records based on a specified value or range of values. The use of like descriptors on different files serves as the link between the falls, thus producing a relational data base. Twenty related files are currently being maintained on PROMIS. Author

**N89-14934*#** National Aeronautics and Space Administration, Washington, DC. Small Business Innovation Research Program.
**PROGRAM SOLICITATION CLOSING DATE: JULY 22, 1988**
1988 102 p
(NASA-TM-101217; NAS 1.15:101217; SBIR-88-1) Avail: NTIS HC A06/MF A01 CSCL 05A

The sixth annual Small Business Innovation Research (SBIR) solicitation by NASA, describes the program, identifies eligibility requirements, outlines proposal preparation and submission requirements, describes the proposal evaluation and award selection process, and provides other information to assist those interested in participating in the SBIR program. It also identifies in Section 8.0 and Appendix D, the specific technical topics and subtopics in which SBIR Phase 1 proposals are solicited in 1988. Author

**N89-14935#** Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
**THE USE OF THINK ALOUD VERBAL PROTOCOLS FOR THE IDENTIFICATION OF MENTAL MODELS**
Harold S. Blackman 1988 3 p Presented at the Human Factors Society Annual Meeting, Anaheim, CA, 24 Oct. 1988
(Contract DE-AC07-76ID-01570)
(DE88-015180; EGG-M-88284; CONF-881058-3) Avail: NTIS HC A02/MF A01

Results regarding the use of protocol analysis techniques are presented to show how they may improve the models identified through other knowledge engineering techniques and how these models may then be used to improve performance through training. Data from two experiments are presented and discussed. DOE

**N89-14936#** Perceptronics, Inc., Woodland Hills, Calif.
**DECOMPOSITION STRATEGIES FOR ELICITING EXPERT KNOWLEDGE: JUDGEMENTS OF DANGEROUSNESS Final Report, Apr. 1983 - Apr. 1987**
Sarah Lichtenstein and Paul Slovic Jun. 1988 31 p
(Contract MDA903-83-C-0198; DA Proj. 2Q1-61102-B-74-F)
(AD-A197913; ARI-RN-88-46) Avail: NTIS HC A03/MF A01 CSCL 23B

This research note discusses one important finding from decision aiding research, that people often have relevant knowledge that they do not use effectively when making a judgement or decision. Research has shown, however, that simple wholistic judgements can be improved upon through an approach that breaks up or decomposes the problem into a series of sub-problems, or components, each of which can be understood more easily and judged separately. The components are the assembled according to a logically prescribed set of combination rules to yield a solution, estimate, or prediction. In the present paper, we outline how a decomposition approach may help a large consortium of expert judges to utilize their own knowledge base more effectively, in an extremely difficult and important judgement task -- (the task examined is assessment of dangerousness among people who have threatened to assassinate the President of the United States). GRA

**N89-14937#** European Space Agency, Paris (France).
**[ESA'S ACTIVITIES REPORT] Annual Report, 1987**
Norman Longdon, ed., T. D. Guyenne, ed., and James Hunt, ed. May 1988 223 p Original contains color illustrations
(ISSN-0258-025X; ETN-89-93586) Copyright Avail: NTIS HC A10/MF A01

The ESA Ulysses, Space Telescope, HIPPARCOS, ISO, STSP, Earthnet, microgravity programs, earth observation programs, telecommunications programs, Ariane 4 and 5 launchers, Hermes,

Columbus, Eureka, and Spacelab research and development are summarized. ESA

# 82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

**N89-14938#** Vrije Univ., Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica.
**ACTIVE INFORMATION RETRIEVAL**
A. J. Kok and A. M. Botman Dec. 1987 22 p
(PB88-226642; IR-143) Avail: NTIS HC A03/MF A01 CSCL 05B

The report gives an overview of an Active Data Base project, a system that helps a user retrieve information from large complex information systems. It describes user modeling by the IMPACT (IMpertinent and ACTive) information retrieval system; the interaction method, which reflects the structure of the information in the model; the data model for similarity of two pieces of data; the systems' use of computed attributes; the classification of values into groups; the contraction function; and the concept of impertinence. GRA

**N89-14939#** National Archives and Records Service, Washington, DC. Archival Research and Evaluation Staff.
**ON 3480 CLASS TAPE CARTRIDGE DRIVES AND ARCHIVAL DATA STORAGE: TECHNOLOGY ASSESSMENT REPORT**
Thomas E. Weir, Jr. Jun. 1988 36 p
(PB88-233135; NARA/TIP-88/04) Avail: NTIS HC A03/MF A01 CSCL 05B

The archival implications of using 3480-class tape cartridges and drives for the long-term storage of data are analyzed. It covers the mechanical and chemical aspects of the cartridges and drives and analyzes the market and technological future of the systems. It is concluded that 3840 class cartridges may serve as archival data storage systems in the future. The National Archives, however, should not make a decision for one year while additional information about 3480 class cartridge drives on minicomputers becomes available and density upgrades occur. Costs of equipment for handling 3480 cartridges also restrict the archives ability to move to 3480 class cartridges. Within 3 to 5 year, the archives will likely have to make a decision about future data storage. GRA

**N89-14940** Michigan Univ., Ann Arbor.
**THE LANGUAGE DISTRIBUTION OF BIBLIOGRAPHIC RECORDS IN SELECTED ONLINE DATABASES Ph.D. Thesis**
Gretchen Whitney 1988 376 p
Avail: Univ. Microfilms Order No. DA8813022

The language distribution of materials included in on-line bibliographic databases between 1970 to 1984 is explored. Eight databases (BIOSIS, Chemical Abstracts, GeoRef, MEDLINE, Criminal Justice, Oceanic Abstracts, PAIS, PsycInfo) on DIALOG were chosen for their world-wide coverage of literature in their respective fields. Trends are accounted for by examining database provider policies and practices. The data are compared with book and serial production statistics, to begin to assess the possible relationship between the databases and the actual availability of literature. The results describe the degree to which English has increased, decreased, or remained stable in relation to other languages, as reflected in the availability of bibliographic record in these data bases. Dissert. Abstr.

**N89-14941#** Sandia National Labs., Albuquerque, N. Mex.
**GREEDI: THE COMPUTERIZATION OF THE DOE/DOD ENVIRONMENTAL DATA BANK**
Charles R. Adams and Elisa M. Kephart (RE/SPEC, Inc., Albuquerque, N. Mex.) 1988 13 p Presented at the 59th Shock and Vibration Symposium, Albuquerque, NM, 18 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-014965; SAND-88-1417C; CONF-881076-3) Avail: NTIS HC A03/MF A01

One of the major responsibilities of Sandia National Laboratories is to develop shock and vibration specifications for system mechanical, electrical, and pyrotechnic components. The data required to generate these specifications are collected from finite element analyses, from laboratory simulation experiments with hardware, and from environmental tests. The production of the component specifications requires the analysis, comparison, and continual updating of these data. Sandia National Laboratories has also maintained the DOE/DOD Environmental Data Bank for over 25 years to assist in its shock and vibration efforts as well as to maintain data for several other types of environments. A means of facilitating shared access to engineering analysis data and providing an integrated environment to perform shock and vibration data analysis tasks was required. An interactive computer code and database system named GREEDI (a Graphical Resource for an Engineering Environmental Database Implementation) was developed and implemented. This transformed the DOE/DOD Environmental Data Bank from a card index system into an easily accessed computerized engineering database tool that can manage data in digitized form. DOE

**N89-14942#** Sandia National Labs., Albuquerque, N. Mex. Applied Mechanics Div.
**DOE/DOD ENVIRONMENTAL DATA BANK**
C. A. Davidson 1988 6 p Presented at the 59th Shock and Vibration Symposium, Albuquerque, NM, 18 Oct. 1988
(Contract DE-AC04-76DP-00789)
(DE88-015262; SAND-88-1429C; CONF-881076-5) Avail: NTIS HC A02/MF A01

The purpose of this paper is to describe an engineering analysis support activity which involves the collection, analysis, storage, and retrieval of technical environmental information. This information is at the disposal of system and component analysts for use in formulating initial conditions, forcing functions and performance requirements for numerous hardware application evaluations. This paper will describe the Engineering Environmental Data Bank system which provides this information service to many Sandia Laboratories' technical analysis efforts and other qualified programs. Its structure and data sources will be summarized. DOE

**N89-14943#** Lawrence Livermore National Lab., CA.
**INTERACTIVE ACCESS TO SCIENTIFIC AND TECHNOLOGICAL FACTUAL DATABASES WORLDWIDE**
Viktor E. Hampel, David P. Grubb, and Amal Moulik Oct. 1987 25 p Presented at the Metallurgical Society Fall Meeting, Cincinnati, OH, 12-14 Oct. 1988
(Contract W-7405-eng-48)
(DE88-016172; UCRL-97617; CONF-881030-2) Avail: NTIS HC A03/MF A01

We describe the performance of the Intelligent Gateway Processor (IGP) as a technical and cost-effective tool for inter-connectivity among heterogeneous resources on geographically distributed networks. The IGP software has been evaluated by several federal agencies and is now operational on over 100 UNIX-based computers from 14 different vendors in the NATO countries and in the United States. We then discuss the IGP capabilities, especially the flexibility and extensibility of the table-driven, interpreter-based system that permits the development of a unified approach to the management of scientific and technological information. This includes the automated interactive access to the large bibliographic databases worldwide, the extraction of relevant sets, compilation into a neutral data exchange format, and trend analysis of emerging technologies by statistical means and time-resolved pattern recognition. The expanding availability of numeric factual databases in science and engineering now also makes it possible to evaluate the leading Chemical Information Management Systems (CIMS) which provide specialized

interfaces to the chemical bibliographies and the nomenclature and structures of substances. DOE

**N89-14944#** Colorado Univ., Boulder. Dept. of Computer Science.
**SELF-ADAPTIVE DATABASES Final Report, 1 Sep. 1985 - 31 Jul. 1988**
Roger King 31 Jul. 1988 106 p
(Contract N00014-86-K-0054)
(AD-A197883; CU-CS-153-7622) Avail: NTIS HC A06/MF A01 CSCL 12E

The self-adaptive databases project at the University of Colorado has produced several substantial results. Parallel algorithms for the maintenance of derived data in an object-oriented database management system have been developed. These algorithms dramatically reduce the amount of I/O necessary to keep complex engineering database entities up to date. Mechanisms have been developed which integrate two directions which have been prominent in the database research community - behavioral and structural (or semantic) object-oriented modeling. This has allowed the support of data objects which are both structurally complex and behaviorally powerful. This is crucial in supporting emerging engineering applications. Also, the project has resulted in the development of mechanisms for the self-adaptive clustering of data and the self-adaptive approach is seen as a promising way to solve the well-known short-coming of relational databases - they are typically too slow to provide proper support of engineering systems. GRA

**N89-14945** Institute for Perception RVO-TNO, Soesterberg (Netherlands). Audiology Group.
**DESCRIPTION OF THE RSG-10 NOISE DATA BASE**
H. J. M. Steeneken and F. W. M. Geurtsen Feb. 1988 36 p
(IZF-1988-03; TD-88-0925; ETN-89-93454) Copyright Avail: Institute for Perception RVO-TNO, P.O. Box 23, 3769 ZG Soesterberg, The Netherlands

Based on a total set of 43 noise signals from military situations, a limited set of noises was selected for a data base. The selection was done by means of a factor analysis, based on the 1/3-octave spectra of the noises. It is shown that with 18 different noise signals (including artificial thermal noise signals) a representative data base can be obtained. These noise signals were recorded on PCM-tape and calibrated carefully. ESA

**N89-14946*#** City Univ. of New York, Staten Island. Dept. of Computer Science.
**RESIDENT DATABASE INTERFACES TO THE DAVID SYSTEM, A HETEROGENEOUS DISTRIBUTED DATABASE MANAGEMENT SYSTEM Final Report**
Marsha Moroh 15 Dec. 1988 12 p
(Grant NAG5-763)
(NASA-CR-184615; NAS 1.26:184615) Avail: NTIS HC A03/MF A01 CSCL 05B

A methodology for building interfaces of resident database management systems to a heterogeneous distributed database management system under development at NASA, the DAVID system, was developed. The feasibility of that methodology was demonstrated by construction of the software necessary to perform the interface task. The interface terminology developed in the course of this research is presented. The work performed and the results are summarized. Author

**N89-14947*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**[TRANSPORTABLE EDUCATIONAL PROGRAMS FOR SCIENTIFIC AND TECHNICAL PROFESSIONALS: MORE EFFECTIVE UTILIZATION OF AUTOMATED SCIENTIFIC AND TECHNICAL DATA BASE SYSTEMS] Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick Oct. 1987 60 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184507; NAS 1.26:184507) Avail: NTIS HC A04/MF A01 CSCL 05B

This grant final report executive summary documents a major, long-term program addressing innovative educational issues associated with the development, administration, evaluation, and widespread distribution of transportable educational programs for scientists and engineers to increase their knowledge of, and facilitate their utilization of automated scientific and technical information storage and retrieval systems. This educational program is of very broad scope, being targeted at Colleges of Engineering and Colleges of Physical sciences at a large number of colleges and universities throughout the United States. The educational program is designed to incorporate extensive hands-on, interactive usage of the NASA RECON system and is supported by a number of microcomputer-based software systems to facilitate the delivery and usage of the educational course materials developed as part of the program. Author

**N89-14948*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**USL/DBMS NASA/RECON WORKING PAPER SERIES. STANDARDS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Frank Y. Chum 29 Mar. 1984 38 p Revised Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184508; NAS 1.26:184508) Avail: NTIS HC A03/MF A01 CSCL 05B

The USL/DBMS NASA/RECON Working Paper Series contains a collection of reports representing results of activities being conducted by the Computer Science Department of the University of Southwestern Louisiana pursuant to the specifications of NASA Contract number NASw-3846. The work on this portion of the contract is being performed jointly by the University of Southwestern Louisiana and Southern University. This report contains the full set of standards for the development, formatting, reviewing, and issuance of entries within the USL/DBMS NASA/RECON Working Paper Series. Author

**N89-14949*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**OVERVIEW OF THE NASA/RECON EDUCATIONAL, RESEARCH, AND DEVELOPMENT ACTIVITIES OF THE COMPUTER SCIENCE DEPARTMENTS OF THE UNIVERSITY OF SOUTHWESTERN LOUISIANA AND SOUTHERN UNIVERSITY Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. 31 May 1984 11 p Revised Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184509; NAS 1.26:184509; DBMS.NASA/RECON-1)
Avail: NTIS HC A03/MF A01 CSCL 05B

This document presents a brief overview of the scope of activities undertaken by the Computer Science Departments of the University of Southern Louisiana (USL) and Southern University (SU) pursuant to a contract with NASA. Presented are only basic identification data concerning the contract activities since subsequent entries within the Working Paper Series will be oriented specifically toward a detailed development and presentation of plans, methodologies, and results of each contract activity. Also included is a table of contents of the entire USL/DBMS NASA/RECON Working Paper Series. Author

**N89-14950*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**NASA RECON: COURSE DEVELOPMENT, ADMINISTRATION, AND EVALUATION. A RESEARCH AND DEVELOPMENT PROPOSAL Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Leroy Roquemore 16 Jan. 1984 67 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184510; NAS 1.26:184510; DBMS.NASA/RECON-2)
Avail: NTIS HC A04/MF A01 CSCL 05B

This proposal addresses the development, administration, and evaluation of a set of transportable, college-level courses to educate science and engineering students in the effective use of automated scientific and technical information storage and retrieval systems, and, in particular, in the use of the NASA RECON system. Chapter 1 presents a brief introduction. Chapter 2 identifies general and specific objectives, i.e., needs analysis, course development, course administration, and course evaluation. Chapter 3 proposes the methodology to be used in successfully accomplishing these objectives. Chapter 4 highlights expected results and product deliverables, and Chapter 5 presents the project evaluation plan to be followed. Chapter 6 is a brief overview of the institutional resources available at the proposing institutions, i.e., at the University of Southwestern Louisiana and at Southern University to support the project. Chapter 7 proposes a budget, time schedule, and management plan. Chapter 8 is a summary of the foregoing.
Author

**N89-14951*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**TRANSPORTABLE, UNIVERSITY-LEVEL EDUCATIONAL PROGRAMS IN INTERACTIVE INFORMATION STORAGE AND RETRIEVAL SYSTEMS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick and Leroy Roquemore 27 Jan. 1984 18 p Presented at the 11th Annual Conference of the Mid-South Association for Educational Data Systems, 22-25 Feb. 1984 Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184511; NAS 1.26:184511; DBMS.NASA/RECON-3)
Avail: NTIS HC A03/MF A01 CSCL 05B

Pursuant to the specifications of a research contract entered into in December, 1983 with NASA, the Computer Science Departments of the University of Southwestern Louisiana and Southern University will be working jointly to address a variety of research and educational issues relating to the use, by non-computer professionals, of some of the largest and most sophiticated interactive information storage and retrieval systems available. Over the projected 6 to 8 year life of the project, in addition to NASA/RECON, the following systems will be examined: Lockheed DIALOG, DOE/RECON, DOD/DTIC, EPA/CSIN, and LLNL/TIS.
Author

**N89-14952*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**THE MAN/MACHINE INTERFACE IN INFORMATION RETRIEVAL: PROVIDING ACCESS TO THE CASUAL USER Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Martin Granier 16 May 1984 71 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184512; NAS 1.26:184512; DBMS.NASA/RECON-4)
Avail: NTIS HC A04/MF A01 CSCL 05B

This study is concerned with the difficulties encountered by casual users wishing to employ Information Storage and Retrieval Systems. A casual user is defined as a professional who has neither time nor desire to pursue in depth the study of the numerous and varied retrieval systems. His needs for on-line search are only occasional, and not limited to any particular system. The paper takes a close look at the state of the art of research concerned with aiding casual users of Information Storage and Retrieval Systems. Current experiments such as LEXIS, CONIT, IIDA, CITE, and CCL are presented and discussed. Comments and proposals are offered, specifically in the areas of training, learning and cost as experienced by the casual user. An extensive bibliography of recent works on the subject follows the text.
Author

**N89-14953*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**KNOWLEDGE BASED SYSTEMS: A PRELIMINARY SURVEY OF SELECTED ISSUES AND TECHNIQUES Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Srinu Kavi 31 May 1984 104 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184513; NAS 1.26:184513; DBMS.NASA/RECON-5)
Avail: NTIS HC A06/MF A01 CSCL 05B

It is only recently that research in Artificial Intelligence (AI) is accomplishing practical results. Most of these results can be attributed to the design and use of expert systems (or Knowledge-Based Systems, KBS) - problem-solving computer programs that can reach a level of performance comparable to that of a human expert in some specialized problem domain. But many computer systems designed to see images, hear sounds, and recognize speech are still in a fairly early stage of development. In this report, a preliminary survey of recent work in the KBS is reported, explaining KBS concepts and issues and techniques used to construct them. Application considerations to construct the KBS and potential KBS research areas are identified. A case study (MYCIN) of a KBS is also provided.
Author

**N89-14954*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**CONCEPTS AND IMPLEMENTATIONS OF NATURAL LANGUAGE QUERY SYSTEMS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and I-Hsiung Liu 1 Jun. 1984 48 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184514; NAS 1.26:184514; DBMS.NASA/RECON-6)
Avail: NTIS HC A03/MF A01 CSCL 05B

The currently developed user language interfaces of information systems are generally intended for serious users. These interfaces commonly ignore potentially the largest user group, i.e., casual users. This project discusses the concepts and implementations of a natural query language system which satisfy the nature and information needs of casual users by allowing them to communicate with the system in the form of their native (natural) language. In addition, a framework for the development of such an interface is also introduced for the MADAM (Multics Approach to Data Access and Management) system at the University of Southwestern Louisiana.
Author

**N89-14955*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**A REPORT ON THE USL NASA/RECON PROJECT. PART 1: THE DEVELOPMENT OF A TRANSPORTABLE, UNIVERSITY LEVEL, IS AND R EDUCATIONAL PROGRAM Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed., Suzy Gallagher, and Martin Granier 4 Oct. 1984 32 p Presented at the 18th Annual Hawaii International Conference on Systems Sciences (HICSS-18), Honolulu, Hawaii, 2-4 Jan. 1985 Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184515; NAS 1.26:184515;
DBMS.NASA/RECON-7-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 05B

A project is described which has as its goal the production of a set of system-independent, discipline-independent, transportable college level courses to educate science and engineering students in the use of large-scale information storage and retrieval systems. This project is being conducted with the cooperation and sponsorship of NASA by R and D teams at the University of Southwest Louisiana and Southern University. Chapter 1 is an introduction, providing an overview and a listing of the management phases. Chapter 2 furnishes general information regarding accomplishments in areas under development. Chapter 3 deals with the development of the course materials by presenting a series of diagrams and keys to depict the progress and

interrelationships of various tasks and sub-tasks. Chapter 4 presents plans for activities to be conducted to complete and deliver course materials. The final chapter is a summary of project objectives, methods, plans, and accomplishments. Author

**N89-14956*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**A REPORT ON THE USL NASA/RECON PROJECT. PART 2: PC-BASED R AND D IN SUPPORT OF IS AND R APPLICATIONS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed., Frank Y. Chum, Philip P. Hall, Dennis R. Moreau, and Spiros Triantafyllopoulos 4 Oct. 1984 22 p Presented at the 18th Annual Hawaii International Conference on Systems Science (HICSS-18), Honolulu, Hawaii, 2-4 Jan. 1985 Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184516; NAS 1.26:184516; DBMS.NASA/RECON-8-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 05B

This Working Paper Series entry describes the PC R and D development effort initiated as part of the NASA/RECON Project at the University of Southwestern Louisiana. This effort involves the development of a PC-based environment for the prototyping and evaluation of various tools designed to enhance the interaction between scientists and engineers and remote information systems. The design of PC-based tools for the enhancement of the NASA/RECON university-level courses is described as well as the design of a multi-functional PC-based workstation to support access to and processing of information from local, distributed, and remote sources. Course preparation activities are described in a companion report entitled A Report on the USL NASA/RECON Project: Part 1, the Development of a Transportable, University-Level, IS and R Educational Program, by Suzy Gallagher and Martin Granier, USL/DBMS NASA/RECON Working Paper Series report number DBMS.NASA/RECON-7. Author

**N89-14957*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**KNOWLEDGE BASED SYSTEMS: A CRITICAL SURVEY OF MAJOR CONCEPTS, ISSUES, AND TECHNIQUES M.S. Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Srinu Kavi 11 Dec. 1984 324 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184517; NAS 1.26:184517; DBMS.NASA/RECON-9) Avail: NTIS HC A14/MF A01 CSCL 05B

This Working Paper Series entry presents a detailed survey of knowledge based systems. After being in a relatively dormant state for many years, only recently is Artificial Intelligence (AI) - that branch of computer science that attempts to have machines emulate intelligent behavior - accomplishing practical results. Most of these results can be attributed to the design and use of Knowledge-Based Systems, KBSs (or ecpert systems) - problem solving computer programs that can reach a level of performance comparable to that of a human expert in some specialized problem domain. These systems can act as a consultant for various requirements like medical diagnosis, military threat analysis, project risk assessment, etc. These systems possess knowledge to enable them to make intelligent desisions. They are, however, not meant to replace the human specialists in any particular domain. A critical survey of recent work in interactive KBSs is reported. A case study (MYCIN) of a KBS, a list of existing KBSs, and an introduction to the Japanese Fifth Generation Computer Project are provided as appendices. Finally, an extensive set of KBS-related references is provided at the end of the report. Author

**N89-14958*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**KNOWLEDGE BASED SYSTEMS: A CRITICAL SURVEY OF MAJOR CONCEPTS, ISSUES AND TECHNIQUES. VISUALS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Srinu Kavi 11 Dec. 1984 67 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184518; NAS 1.26:184518; DBMS.NASA/RECON-10) Avail: NTIS HC A04/MF A01 CSCL 05B

This Working Paper Series entry represents a collection of presentation visuals associated with the companion report entitled, Knowledge Based Systems: A Critical Survey of Major Concepts, Issues, and Techniques, USL/DBMS NASA/RECON Working Paper Series report number DBMS.NASA/RECON-9. The objectives of the report are to: examine various techniques used to build the KBS; to examine at least one KBS in detail, i.e., a case study; to list and identify limitations and problems with the KBS; to suggest future areas of research; and to provide extensive reference materials. Author

**N89-14959*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**AN OVERVIEW OF SELECTED INFORMATION STORAGE AND RETRIEVAL ISSUES IN COMPUTERIZED DOCUMENT PROCESSING Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Valentine U. Ihebuzor 29 Dec. 1984 51 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184519; NAS 1.26:184519; DBMS.NASA/RECON-11) Avail: NTIS HC A04/MF A01 CSCL 05B

The rapid development of computerized information storage and retrieval techniques has introduced the possibility of extending the word processing concept to document processing. A major advantage of computerized document processing is the relief of the tedious task of manual editing and composition usually encountered by traditional publishers through the immense speed and storage capacity of computers. Furthermore, computerized document processing provides an author with centralized control, the lack of which is a handicap of the traditional publishing operation. A survey of some computerized document processing techniques is presented with emphasis on related information storage and retrieval issues. String matching algorithms are considered central to document information storage and retrieval and are also discussed. Author

**N89-14960*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**AN INNOVATIVE, MULTIDISCIPLINARY EDUCATIONAL PROGRAM IN INTERACTIVE INFORMATION STORAGE AND RETRIEVAL M.S. Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Mary C. Gallagher 7 Feb. 1985 161 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184520; NAS 1.26:184520; DBMS.NASA/RECON-12) Avail: NTIS HC A08/MF A01 CSCL 05B

There exists a large number of large-scale bibliographic Information Storage and Retrieval Systems containing large amounts of valuable data of interest in a wide variety of research applications. These systems are not used to capacity because the end users, i.e., the researchers, have not been trained in the techniques of accessing such systems. This thesis describes the development of a transportable, university-level course in methods of querying on-line interactive Information Storage and Retrieval systems as a solution to this problem. This course was designed to instruct upper division science and engineering students to enable these end users to directly access such systems. The course is designed to be taught by instructors who are not specialists in either computer science or research skills. It is independent of any particular IS and R system or computer hardware. The project is sponsored by NASA and conducted by the University of Southwestern Louisiana and Southern University. Author

**N89-14961*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**AN INNOVATIVE, MULTIDISCIPLINARY EDUCATIONAL PROGRAM IN INTERACTIVE INFORMATION STORAGE AND RETRIEVAL. PRESENTATION VISUALS M.S. Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Mary C. Gallagher 7 Feb. 1985 35 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184521; NAS 1.26:184521; DBMS.NASA/RECON-13)
Avail: NTIS HC A03/MF A01 CSCL 05B

This Working Paper Series entry represents a collection of presentation visuals associated with the companion report entitled An Innovative, Multidisciplinary Educational Program in Interactive Information Storage and Retrieval, USL/DBMS NASA/RECON Working Paper Series report number DBMS.NASA/RECON-12. The project objectives are to develop a set of transportable, hands-on, data base management courses for science and engineering students to facilitate their utilization of information storage and retrieval programs. Author

**N89-14962*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**USL NASA/RECON PROJECT PRESENTATIONS AT THE 1985 ACM COMPUTER SCIENCE CONFERENCE: ABSTRACTS AND VISUALS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed., Frank Y. Chum, Suzy Gallagher, Martin Granier, Philip P. Hall, Dennis R. Moreau, and Spiros Triantafyllopoulos 10 Mar. 1985 82 p Conference held in New Orleans, LA, 12-14 Mar. 1985 Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184522; NAS 1.26:184522; DBMS.NASA/RECON-14)
Avail: NTIS HC A05/MF A01 CSCL 05B

This Working Paper Series entry represents the abstracts and visuals associated with presentations delivered by six USL NASA/RECON research team members at the above named conference. The presentations highlight various aspects of NASA contract activities pursued by the participants as they relate to individual research projects. The titles of the six presentations are as follows: (1) The Specification and Design of a Distributed Workstation; (2) An Innovative, Multidisciplinary Educational Program in Interactive Information Storage and Retrieval; (3) Critical Comparative Analysis of the Major Commercial IS and R Systems; (4) Design Criteria for a PC-Based Common User Interface to Remote Information Systems; (5) The Design of an Object-Oriented Graphics Interface; and (6) Knowledge-Based Information Retrieval: Techniques and Applications. Author

**N89-14963*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**THE DESIGN OF PC/MISI, A PC-BASED COMMON USER INTERFACE TO REMOTE INFORMATION STORAGE AND RETRIEVAL SYSTEMS M.S. Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Philip P. Hall 24 Apr. 1985 97 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184523; NAS 1.26:184523; DBMS.NASA/RECON-15)
Avail: NTIS HC A05/MF A01 CSCL 05B

The amount of information contained in the data bases of large-scale information storage and retrieval systems is very large and growing at a rapid rate. The methods available for assessing this information have not been successful in making the information easily available to the people who have the greatest need for it. This thesis describes the design of a personal computer based system which will provide a means for these individuals to retrieve this data through one standardized interface. The thesis identifies each of the major problems associated with providing access to casual users of IS and R systems and describes the manner in which these problems are to be solved by the utilization of the local processing power of a PC. Additional capabilities, not available with standard access methods, are also provided to improve the user's ability to make use of this information. The design of PC/MISI is intended to facilitate its use as a research vehicle. Evaluation mechanisms and possible areas of future research are described. The PC/MISI development effort is part of a larger research effort directed at improving access to remote IS and R systems. This research effort, supported in part by NASA, is also reviewed. Author

**N89-14964*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**THE DESIGN OF PC/MISI, A PC-BASED COMMON USER INTERFACE TO REMOTE INFORMATION STORAGE AND RETRIEVAL SYSTEMS. PRESENTATION VISUALS M.S. Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Philip P. Hall 24 Apr. 1985 31 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184524; NAS 1.26:184524; DBMS.NASA/RECON-16)
Avail: NTIS HC A03/MF A01 CSCL 05B

This Working Paper Series entry represents a collection of presentation visuals associated with the companion report entitled, The Design of PC/MISI, a PC-Based Common User Interface to Remote Information Storage and Retrieval Systems, USL/DBMS NASA/RECON Working Paper Series report number DBMS.NASA/RECON-15. The paper discusses the following: problem definition; the PC solution; the goals of system design; the design description; future considerations, the research environment; conclusions. Author

**N89-14965*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**NATURAL LANGUAGE QUERY SYSTEM DESIGN FOR INTERACTIVE INFORMATION STORAGE AND RETRIEVAL SYSTEMS M.S. Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and I-Hsiung Liu 22 Apr. 1985 174 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184525; NAS 1.26:184525; DBMS.NASA/RECON-17)
Avail: NTIS HC A08/MF A01 CSCL 05B

The currently developed multi-level language interfaces of information systems are generally designed for experienced users. These interfaces commonly ignore the nature and needs of the largest user group, i.e., casual users. This research identifies the importance of natural language query system research within information storage and retrieval system development; addresses the topics of developing such a query system; and finally, proposes a framework for the development of natural language query systems in order to facilitate the communication between casual users and information storage and retrieval systems. Author

**N89-14966*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**NATURAL LANGUAGE QUERY SYSTEM DESIGN FOR INTERACTIVE INFORMATION STORAGE AND RETRIEVAL SYSTEMS. PRESENTATION VISUALS M.S. Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and I-Hsiung Liu 22 Apr. 1985 53 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184526; NAS 1.26:184526; DBMS.NASA/RECON-18)
Avail: NTIS HC A04/MF A01 CSCL 05B

This Working Paper Series entry represents a collection of presentation visuals associated with the companion report entitled Natural Language Query System Design for Interactive Information Storage and Retrieval Systems, USL/DBMS NASA/RECON Working Paper Series report number DBMS.NASA/RECON-17. Author

**N89-14967*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**AN HIERARCHICAL APPROACH TO PERFORMANCE EVALUATION OF EXPERT SYSTEMS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Srinu Kavi 6 May 1985 42 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184527; NAS 1.26:184527; DBMS.NASA/RECON-19)
Avail: NTIS HC A03/MF A01 CSCL 05B

The number and size of expert systems is growing rapidly. Formal evaluation of these systems - which is not performed for many systems - increases the acceptability by the user community and hence their success. Hierarchical evaluation that had been conducted for computer systems is applied for expert system performance evaluation. Expert systems are also evaluated by treating them as software systems (or programs). This paper reports many of the basic concepts and ideas in the Performance Evaluation of Expert Systems Study being conducted at the University of Southwestern Louisiana. Author

**N89-14968*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**SOME ISSUES IN DATA MODEL MAPPING Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Jamal R. Alsabbagh 10 May 1985 26 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184528; NAS 1.26:184528; DBMS.NASA/RECON-20)
Avail: NTIS HC A03/MF A01 CSCL 05B

Numerous data models have been reported in the literature since the early 1970's. They have been used as database interfaces and as conceptual design tools. The mapping between schemas expressed according to the same data model or according to different models is interesting for theoretical and practical purposes. This paper addresses some of the issues involved in such a mapping. Of special interest are the identification of the mapping parameters and some current approaches for handling the various situations that require a mapping. Author

**N89-14969*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**KARL: A KNOWLEDGE-ASSISTED RETRIEVAL LANGUAGE M.S. Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Spiros Triantafyllopoulos 31 Oct. 1985 158 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184529; NAS 1.26:184529; DBMS.NASA/RECON-21)
Avail: NTIS HC A08/MF A01 CSCL 05B

Data classification and storage are tasks typically performed by application specialists. In contrast, information users are primarily non-computer specialists who use information in their decision-making and other activities. Interaction efficiency between such users and the computer is often reduced by machine requirements and resulting user reluctance to use the system. This thesis examines the problems associated with information retrieval for non-computer specialist users, and proposes a method for communicating in restricted English that uses knowledge of the entities involved, relationships between entities, and basic English language syntax and semantics to translate the user requests into formal queries. The proposed method includes an intelligent dictionary, syntax and semantic verifiers, and a formal query generator. In addition, the proposed system has a learning capability that can improve portability and performance. With the increasing demand for efficient human-machine communication, the significance of this thesis becomes apparent. As human resources become more valuable, software systems that will assist in improving the human-machine interface will be needed and research addressing new solutions will be of utmost importance. This thesis presents an initial design and implementation as a foundation for further research and development into the emerging field of natural language database query systems. Author

**N89-14970*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**KARL: A KNOWLEDGE-ASSISTED RETRIEVAL LANGUAGE. PRESENTATION VISUALS M.S. Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Spiros Triantafyllopoulos 31 Oct. 1985 54 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184530; NAS 1.26:184530; DBMS.NASA/RECON-22)
Avail: NTIS HC A04/MF A01 CSCL 05B

A collection of presentation visuals associated with the companion report entitled KARL: A Knowledge-Assisted Retrieval Language, is presented. Information is given on data retrieval, natural language database front ends, generic design objectives, processing capabilities and the query processing cycle. Author

**N89-14971*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**A SURVEY OF CHEMICAL INFORMATION SYSTEMS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Aneesa Bashir Shaikh 5 Dec. 1985 165 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184531; NAS 1.26:184531; DBMS.NASA/RECON-23)
Avail: NTIS HC A08/MF A01 CSCL 05B

A survey of the features, functions, and characteristics of a fairly wide variety of chemical information storage and retrieval systems currently in operation is given. The types of systems (together with an identification of the specific systems) addressed within this survey are as follows: patents and bibliographies (Derwent's Patent System; IFI Comprehensive Database; PULSAR); pharmacology and toxicology (Chemfile; PAGODE; CBF; HEEDA; NAPRALERT; MAACS); the chemical information system (CAS Chemical Registry System; SANSS; MSSS; CSEARCH; GINA; NMRLIT; CRYST; XTAL; PDSM; CAISF; RTECS Search System; AQUATOX; WDROP; OHMTADS; MLAB; Chemlab); spectra (OCETH; ASTM); crystals (CRYSRC); and physical properties (DETHERM). Summary characteristics and current trends in chemical information systems development are also examined. Author

**N89-14972*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**A METHODOLOGY FOR THE DESIGN AND EVALUATION OF USER INTERFACES FOR INTERACTIVE INFORMATION SYSTEMS Ph.D. Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Mohammad U. Farooq 22 Jan. 1986 112 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184532; NAS 1.26:184532; DBMS.NASA/RECON-24)
Avail: NTIS HC A06/MF A01 CSCL 05B

The definition of proposed research addressing the development and validation of a methodology for the design and evaluation of user interfaces for interactive information systems is given. The major objectives of this research are: the development of a comprehensive, objective, and generalizable methodology for the design and evaluation of user interfaces for information systems; the development of equations and/or analytical models to characterize user behavior and the performance of a designed interface; the design of a prototype system for the development and administration of user interfaces; and the design and use of controlled experiments to support the research and test/validate the proposed methodology. The proposed design methodology views the user interface as a virtual machine composed of three layers: an interactive layer, a dialogue manager layer, and an

application interface layer. A command language model of user system interactions is presented because of its inherent simplicity and structured approach based on interaction events. All interaction events have a common structure based on common generic elements necessary for a successful dialogue. It is shown that, using this model, various types of interfaces could be designed and implemented to accommodate various categories of users. The implementation methodology is discussed in terms of how to store and organize the information. Author

**N89-14973*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**AN OVERVIEW OF THE USL/DBMS NASA/PC R AND D PROJECT WORKING PAPER SERIES Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. 15 Aug. 1984 8 p Revised Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184533; NAS 1.26:184533; DBMS.NASA/PC-R/D-1)
Avail: NTIS HC A02/MF A01 CSCL 05B

An introduction is given to the University of Southwestern Louisiana Data Base Management System (USL/DBMS) NASA/PC R and D Working Paper Series which has been established to provide a foundation for both a formal and informal information dissemination mechanism concerning PC-based research and development activities being performed pursuant to the NASA contract. This entry also serves as an index to the collection of Working Paper Series reports. Author

**N89-14974*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**THE USL NASA PC R AND D PROJECT: GENERAL SPECIFICATIONS OF OBJECTIVES Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. 6 Jun. 1984 8 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184534; NAS 1.26:184534; DBMS.NASA/PC-R/D-2)
Avail: NTIS HC A02/MF A01 CSCL 05B

Given here are the general specifications of the objectives of the University of Southwestern Louisiana Data Base Management System (USL/DBMS) NASA PC R and D Project, a project initiated to address future R and D issues related to PC-based processing environments acquired pursuant to the NASA contract work; namely, the IBM PC/XT systems. Author

**N89-14975*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**THE USL NASA PC R AND D DEVELOPMENT ENVIRONMENT STANDARDS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Dennis R. Moreau 31 Jul. 1984 10 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184535; NAS 1.26:184535; DBMS.NASA/PC-R/D-3)
Avail: NTIS HC A02/MF A01 CSCL 05B

The development environment standards which have been established in order to control usage of the IBM PC/XT development systems and to prevent interference between projects being currently developed on the PC's are discussed. The standards address the following areas: scheduling PC resources; login/logout procedures; training; file naming conventions; hard disk organization; diskette care; backup procedures; and copying policies. Author

**N89-14976*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**GENERAL SPECIFICATIONS FOR THE DEVELOPMENT OF A PC-BASED SIMULATOR OF THE NASA RECON SYSTEM Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Spiros Triantafyllopoulos 2 Aug. 1984 23 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184536; NAS 1.26:184536; DBMS.NASA/PC-R/D-4)
Avail: NTIS HC A03/MF A01 CSCL 05B

The general specifications for the design and implementation of an IBM PC/XT-based simulator of the NASA RECON system, including record designs, file structure designs, command language analysis, program design issues, error recovery considerations, and usage monitoring facilities are discussed. Once implemented, such a simulator will be utilized to evaluate the effectiveness of simulated information system access in addition to actual system usage as part of the total educational programs being developed within the NASA contract. Author

**N89-14977*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**GENERAL SPECIFICATIONS FOR THE DEVELOPMENT OF A USL NASA PC R AND D STATISTICAL ANALYSIS SUPPORT PACKAGE Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed., Jinous Bassari, and Spiros Triantafyllopoulos 2 Aug. 1984 16 p Prepared in cooperation with Southern Univ., Baton Rouge, La.
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184537; NAS 1.26:184537; DBMS.NASA/PC-R/D-5)
Avail: NTIS HC A03/MF A01 CSCL 05B

The University of Southwestern Louisiana (USL) NASA PC R and D statistical analysis support package is designed to be a three-level package to allow statistical analysis for a variety of applications within the USL Data Base Management System (DBMS) contract work. The design addresses usage of the statistical facilities as a library package, as an interactive statistical analysis system, and as a batch processing package. Author

**N89-14978*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**GENERAL SPECIFICATIONS FOR THE DEVELOPMENT OF A USL/DBMS NASA/PC R AND D DISTRIBUTED WORKSTATION Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Frank Y. Chum 15 Aug. 1984 12 p Prepared in cooperation with Southern Univ., Baton Rouge, La.
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184538; NAS 1.26:184538; DBMS.NASA/PC-R/D-6)
Avail: NTIS HC A03/MF A01 CSCL 05B

The general specifications for the development of a PC-based distributed workstation (PCDWS) for an information storage and retrieval systems environment are defined. This research proposes the development of a PCDWS prototype as part of the University of Southwestern Louisiana Data Base Management System (USL/DBMS) NASA/PC R and D project in the PC-based workstation environment. Author

**N89-14979*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**THE USL NASA PC R AND D INTERACTIVE PRESENTATION DEVELOPMENT SYSTEM Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Dennis R. Moreau 2 Aug. 1984 10 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184539; NAS 1.26:184539; DBMS.NASA/PC-R/D-7)
Avail: NTIS HC A02/MF A01 CSCL 05B

The Interactive Presentation Development System (IPFS) is a highly interactive system for creating, editing, and displaying video presentation sequences, e.g., for developing and presenting displays of instructional material similiar to overhead transparency or slide presentations. However, since this system is PC-based, users (instructors) can step through sequences forward or backward, focusing attention to areas of the display with special cursor pointers. Additionally, screen displays may be dynamically modified during the presentation to show assignments or to answer questions, much like a traditional blackboard. This system is now

implemented at the University of Southwestern Louisiana for use within the piloting phases of the NASA contract work. Author

**N89-14980*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**THE USL NASA PC R AND D PROJECT: DETAILED SPECIFICATIONS OF OBJECTS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed., Frank Y. Chum, Philip P. Hall, Dennis R. Moreau, and Spiros Triantafyllopoulos 15 Aug. 1984 23 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184540; NAS 1.26:184540; DBMS.NASA/PC-R/D-8)
Avail: NTIS HC A03/MF A01 CSCL 05B

The specifications for a number of projects which are to be implemented within the University of Southwestern Louisiana NASA PC R and D Project are discussed. The goals and objectives of the PC development project and the interrelationships of the various components are discussed. Six projects are described. They are a NASA/RECON simulator, a user interface to multiple remote information systems, evaluation of various personal computer systems, statistical analysis software development, interactive presentation system development, and the development of a distributed processing environment. The relationships of these projects to one another and to the goals and objectives of the overall project are discussed. Author

**N89-14981*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**DESIGN CRITERIA FOR A PC-BASED COMMON USER INTERFACE TO REMOTE INFORMATION SYSTEMS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Philip P. Hall 13 Aug. 1984 23 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184541; NAS 1.26:184541; DBMS.NASA/PC-R/D-9)
Avail: NTIS HC A03/MF A01 CSCL 05B

A set of design criteria are presented which will allow the implementation of an interface to multiple remote information systems on a microcomputer. The focus of the design description is on providing the user with the functionality required to retrieve, store and manipulate data residing in remote information systems through the utilization of a standardized interface system. The intent is to spare the user from learning the details of retrieval from specific systems while retaining the full capabilities of each system. The system design includes multi-level capabilities to enhance usability by a wide range of users and utilizes microcomputer graphics capabilities where applicable. A data collection subsystem for evaluation purposes is also described. Author

**N89-14982*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**A PERFORMANCE EVALUATION OF THE IBM 370/XT PERSONAL COMPUTER Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Spiros Triantafyllopoulos 5 Oct. 1984 49 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184542; NAS 1.26:184542; DBMS.NASA/PC-R/D-10)
Avail: NTIS HC A03/MF A01 CSCL 05B

An evaluation of the IBM 370/XT personal computer is given. This evaluation focuses primarily on the use of the 370/XT for scientific and technical applications and applications development. A measurement of the capabilities of the 370/XT was performed by means of test programs which are presented. Also included is a review of facilities provided by the operating system (VM/PC), along with comments on the IBM 370/XT hardware configuration. Author

**N89-14983*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**USL/DBMS NASA/PC R AND D PROJECT C PROGRAMMING STANDARDS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Dennis R. Moreau 5 Oct. 1984 13 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184543; NAS 1.26:184543; DBMS.NASA/PC-R/D-11)
Avail: NTIS HC A03/MF A01 CSCL 05B

A set of programming standards intended to promote reliability, readability, and portability of C programs written for PC research and development projects is established. These standards must be adhered to except where reasons for deviation are clearly identified and approved by the PC team. Any approved deviation from these standards must also be clearly documented in the pertinent source code. Author

**N89-14984*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**USL/DBMS NASA/PC R AND D PROJECT SYSTEM DESIGN STANDARDS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Dennis R. Moreau 12 Oct. 1984 7 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184544; NAS 1.26:184544; DBMS.NASA/PC-R/D-12)
Avail: NTIS HC A02/MF A01 CSCL 05B

A set of system design standards intended to assure the completeness and quality of designs developed for PC research and development projects is established. The standards presented address the areas of problem definition, initial design plan, design specification, and re-evaluation. Author

**N89-14985*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**USL/DBMS NASA/PC R AND D PROJECT SYSTEM TESTING STANDARDS Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed., Srinu Kavi, Dennis R. Moreau, and Lin Yan 12 Oct. 1984 7 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184545; NAS 1.26:184545; DBMS.NASA/PC-R/D-13)
Avail: NTIS HC A02/MF A01 CSCL 05B

A set of system testing standards to be used in the development of all C software within the NASA/PC Research and Development Project is established. Testing will be considered in two phases: the program testing phase and the system testing phase. The objective of these standards is to provide guidelines for the planning and conduct of program and software system testing. Author

**N89-14986*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**IBM PC/IX OPERATING SYSTEM EVALUATION PLAN Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed., Martin Granier, Philip P. Hall, and Spiros Triantafyllopoulos 28 Nov. 1984 11 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184546; NAS 1.26:184546; DBMS.NASA/PC-R/D-14)
Avail: NTIS HC A03/MF A01 CSCL 05B

An evaluation plan for the IBM PC/IX Operating System designed for IBM PC/XT computers is discussed. The evaluation plan covers the areas of performance measurement and evaluation, software facilities available, man-machine interface considerations, networking, and the suitability of PC/IX as a development environment within the University of Southwestern Louisiana NASA PC Research and Development project. In order to compare and evaluate the PC/IX system, comparisons with other available UNIX-based systems are also included. Author

**N89-14987*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**PC-BASED MULTIPLE INFORMATION SYSTEM INTERFACE (PC/MISI) DESIGN PLAN Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Philip P. Hall 13 Jan. 1985 15 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184547; NAS 1.26:184547; DBMS.NASA/PC-R/D-15)
Avail: NTIS HC A03/MF A01 CSCL 05B

The general design plan for the implementation of a common user interface to multiple remote information systems within a microcomputer-based environment is presented. The intent is to provide a framework for the development of detailed specifications which will be used as guidelines for the actual development of the system. Author

**N89-14988*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**PC-BASED MULTIPLE INFORMATION SYSTEM INTERFACE (PC/MISI) DETAILED DESIGN AND IMPLEMENTATION PLAN Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Philip P. Hall 10 Apr. 1985 71 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184548; NAS 1.26:184548; DBMS.NASA/PC-R/D-16)
Avail: NTIS HC A04/MF A01 CSCL 05B

The design plan for the personal computer multiple information system interface (PC/MISI) project is discussed. The document is intended to be used as a blueprint for the implementation of the system. Each component is described in the detail necessary to allow programmers to implement the system. A description of the system data flow and system file structures is given. Author

**N89-14989*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**AN OVERVIEW OF THE EVALUATION PLAN FOR PC/MISI: PC-BASED MULTIPLE INFORMATION SYSTEM INTERFACE Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed., Bee Lee Lim, and Philip P. Hall 24 Apr. 1985 29 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184549; NAS 1.26:184549; DBMS.NASA/PC-R/D-17)
Avail: NTIS HC A03/MF A01 CSCL 05B

An initial evaluation plan for the personal computer multiple information system interface (PC/MISI) project is discussed. The document is intend to be used as a blueprint for the evaluation of this system. Each objective of the design project is discussed along with the evaluation parameters and methodology to be used in the evaluation of the implementation's achievement of those objectives. The potential of the system for research activities related to more general aspects of information retrieval is also discussed. Author

**N89-14990*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**NASA PC SOFTWARE EVALUATION PROJECT Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Julie C. Kuan 24 Jan. 1986 31 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184550; NAS 1.26:184550; DBMS.NASA/PC-R/D-18)
Avail: NTIS HC A03/MF A01 CSCL 05B

The USL NASA PC software evaluation project is intended to provide a structured framework for facilitating the development of quality NASA PC software products. The project will assist NASA PC development staff to understand the characteristics and functions of NASA PC software products. Based on the results of the project teams' evaluations and recommendations, users can judge the reliability, usability, acceptability, maintainability and customizability of all the PC software products. The objective here is to provide initial, high-level specifications and guidelines for NASA PC software evaluation. The primary tasks to be addressed in this project are as follows: to gain a strong understanding of what software evaluation entails and how to organize a structured software evaluation process; to define a structured methodology for conducting the software evaluation process; to develop a set of PC software evaluation criteria and evaluation rating scales; and to conduct PC software evaluations in accordance with the identified methodology. Communication Packages, Network System Software, Graphics Support Software, Environment Management Software, General Utilities. This report represents one of the 72 attachment reports to the University of Southwestern Louisiana's Final Report on NASA Grant NGT-19-010-900. Accordingly, appropriate care should be taken in using this report out of context of the full Final Report. Author

**N89-14991*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**OBJECT-ORIENTED SYSTEMS: AN ANNOTATED BIBLIOGRAPHY Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed., Cherie T. Powell, and Dennis R. Moreau 10 Dec. 1986 28 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184551; NAS 1.26:184551; DBMS.NASA/PC-R/D-19)
Avail: NTIS HC A03/MF A01 CSCL 05B

A comprehensive annotated bibliography of journal publications, conference publications, and books related to object-oriented systems is discussed. Author

**N89-14992*#** University of Southwestern Louisiana. Lafayette. Center for Advanced Computer Studies.
**A PROGRAMMING ENVIRONMENT EVALUATION METHODOLOGY FOR OBJECT-ORIENTED SYSTEMS Ph.D Thesis Final Report, 1 Jul. 1985 - 31 Dec. 1987**
Wayne D. Dominick, ed. and Dennis R. Moreau Sep. 1987 184 p Prepared in cooperation with Southern Univ., Baton Rouge, LA
(Contract NASw-3846; NGT-19-010-900)
(NASA-CR-184552; NAS 1.26:184552; DBMS.NASA/PC-R/D-20)
Avail: NTIS HC A09/MF A01 CSCL 05B

The object-oriented design strategy as both a problem decomposition and system development paradigm has made impressive inroads into the various areas of the computing sciences. Substantial development productivity improvements have been demonstrated in areas ranging from artificial intelligence to user interface design. However, there has been very little progress in the formal characterization of these productivity improvements and in the identification of the underlying cognitive mechanisms. The development and validation of models and metrics of this sort require large amounts of systematically-gathered structural and productivity data. There has, however, been a notable lack of systematically-gathered information on these development environments. A large part of this problem is attributable to the lack of a systematic programming environment evaluation methodology that is appropriate to the evaluation of object-oriented systems. Author

**N89-14993#** Technische Hogeschool, Delft (Netherlands). Faculty of Technical Mathematics and Informatics.
**DATA BASES: MANAGEMENT OF COMPLEX DATA STRUCTURES USING THE SEMANTIC DATA MODEL [DATABASES: BEHEER VAN COMPLEXE GEGEVENSSTRUCTUREN DOOR TOEPASSING VAN HET SEMANTISCHE DATAMODEL]**
Bert Bakker 1988 27 p In DUTCH
(Rept-88-34; B8823228; ETN-89-93370; ISSN-0920-2358)
Copyright Avail: NTIS HC A03/MF A01

Basic information concerning data management and design of data bases is presented in order to evaluate the advantages and disadvantages in the purchase of a data base management system. Data integrity is essential. Response time can also be important. Two data models, the relational and the semantic model, leading to the most usable systems, were compared. The superiority of

the semantic model is demonstrated. Its inherent advantages are that the surveillance of the reference integrity can be deduced from the type definitions, its relatively simple manipulation, that no joint operation is required in case of questions, and that it supports specialization. ESA

**N89-14994*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**LARCMACS: A TEX MACRO SET FOR TYPESETTING NASA REPORTS**
Linda H. Woessner and Mary K. McCaskill Dec. 1988 122 p
(NASA-TM-101522; NAS 1.15:101522) Avail: NTIS HC A06/MF A01 CSCL 05B

This LARCMACS user's manual describes the February 1988 version of LARCMACS, the TEX macro set used by the Technical Editing Branch (TEB) at NASA Langley Research Center. These macros were developed by the authors to facilitate the typesetting of NASA formal reports. They are also useful, however, for informal NASA reports and other technical documents such as meeting papers. LARCMACS are distributed by TEB for the convenience of the Langley TEX user community. LARCMACS contain macros for obtaining the standard double-column format for NASA reports, for typesetting tables in the ruled format traditional in NASA reports, and for typesetting difficult mathematical expressions. Each macro is described and numerous examples are included. Definitions of the LARCMACS macros are also included. Author

# 83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

# 84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

**N89-14995*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**WELCOME TO AMES RESEARCH CENTER (1987 FORUM ON FEDERAL TECHNOLOGY TRANSFER)**
William F. Ballhaus, Jr. Nov. 1988 15 p
(NASA-TM-100088; A-88124; NAS 1.15:100088) Avail: NTIS HC A03/MF A01 CSCL 05D

NASA Ames Research Center has a long and distinguished history of technology development and transfer. Recently, in a welcoming speech to the Forum on Federal Technology Transfer, Director Ballhouse of Ames described significant technologies which have been transferred from Ames to the private sector and identifies future opportunities. Author

# 85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

**N89-14996#** Department of Energy, Washington, DC.
**RESEARCH AND TECHNOLOGY UTILIZATION**
Aug. 1988 149 p
(DE88-016749; DOE/S-0067) Avail: NTIS HC A07/MF A01

This report responds to the request of the Secretary of Energy to evaluate the technology transfer programs of the DOE and its laboratories and to make recommendations to improve national economic competitiveness through the transfer of DOE science and technology to American industry. The report describes the current technology transfer policies and practices of the DOE and its major research and development programs. It considers the transfer efforts of the multiprogram laboratories and several of the single purpose laboratories. Current activities are examined in the light of recent changes in legislation, proprietary practices and attitudes, and they are compared to past successes and failures. The report also examines the views of industrial companies on the benefits of DOE technology and the role of U.S. research universities in technology transfer. DOE

**N89-14997#** Sandia National Labs., Albuquerque, N. Mex.
**TECHNOLOGY TRANSFER: TRANSFERRING FEDERAL R AND D RESULTS FOR DOMESTIC COMMERCIAL UTILIZATION**
J. P. DeBrium and J. D. Corey Aug. 1988 153 p
(Contract DE-AC04-76DP-00789)
(DE89-000419; SAND-88-1716) Avail: NTIS HC A08/MF A01

This study is intended to provide a policy-oriented overview and grounding in concepts, issues, and considerations involved in the complex field of Federal technology transfer. It is intended primarily for policy planners and higher-level decision-makers concerned with Federal technology transfer, but at the same time it should provide a good introduction to the field for all technology transfer personnel. A primary objective of this study is to assemble, condense, and interpret a significant amount of the existing knowledge and wisdom relating to technology transfer. It further attempts to clarify and comment on the important issues and concerns which affect the Federal sector, and the Department of Energy in particular. No document on technology transfer can be the final word or deal comprehensively with all topics, but hopefully this study will make a substantial contribution to the practice and practical application of Federal technology transfer. DOE

# 88 SPACE SCIENCES (GENERAL)

**N89-14998*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**EXPERIMENTS IN PLANETARY AND RELATED SCIENCES AND THE SPACE STATION**
Ronald Greeley, ed. (Arizona State Univ., Tempe.) and Richard J. Williams, ed. Washington, DC Nov. 1987 188 p Workshop held in Tempe, AZ, 15-16 Sep. 1986
(Contracts NCC9-14; NAS9-17023)
(NASA-CP-2494; S-566; NAS 1.55:2494) Avail: NTIS HC A09/MF A01 CSCL 03B

Numerous workshops were held to provide a forum for discussing the full range of possible experiments, their science rationale, and the requirements on the Space Station, should such experiments eventually be flown. During the workshops, subgroups met to discuss areas of common interest. Summaries of each group and abstracts of contributed papers as they developed from a workshop on September 15 to 16, 1986, are included. Topics addressed include: planetary impact experimentation; physics of windblown particles; particle formation and interaction; experimental cosmochemistry in the space station; and an overview of the program to place advanced automation and robotics on the space station. For individual titles, see N89-14999 through N89-15046.

**N89-14999*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**PLANETARY IMPACT EXPERIMENTATION** **c91**
Mark J. Cintala, Peter H. Schultz (Brown Univ., Providence, RI.), and Friedrich Hoerz *In its* Experiments in Planetary and Related

Sciences and the Space Station Nov. 1987 16 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

An understanding of impact processes in low- and microgravity environments would be advanced significantly by the construction and use of an impact facility on the Space Station. It is proposed that initial studies begin as soon as possible in ground-based impact laboratories, on the NASA KC-135 Reduced-Gravity Aircraft, and in existing drop towers. The resulting experience and information base could then be applied toward an experiment package designed for use on Shuttle orbiters to support pilot studies in orbital environments. These experiments, as well as the first efforts made on the IOC Space Station, should involve the impact of various free-floating targets; such studies would yield a substantial scientific return while providing valuable experience and engineering information for use in refining the design of the dedicated Space Station Impact Facility. The dedicated facility should be designed to support impact experimentation, including but not limited to cratering, asteroid and ring-particle dynamics, and accretional processes. Author

**N89-15000*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**PHYSICS OF WINDBLOWN PARTICLES c91**
Ronald Greeley, Rodman Leach, John R. Marshall, Bruce White, James D. Iversen, William G. Nickling, Dale Gillette, and Michael Sorensen (Aarhus Univ., Denmark ) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 29 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

A laboratory facility proposed for the Space Station to investigate fundamental aspects of windblown particles is described. The experiments would take advantage of the environment afforded in earth orbit and would be an extension of research currently being conducted on the geology and physics of windblown sediments on earth, Mars, and Venus. Aeolian (wind) processes are reviewed in the planetary context, the scientific rational is given for specific experiments to be conducted, the experiment apparatus (the Carousel Wind Tunnel, or CWT) is described, and a plan presented for implementing the proposed research program. Author

**N89-15001*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**PARTICLE FORMATION AND INTERACTION c91**
Steven Squyres, George J. Corso, Lynn D. Griffiths, Ian D. R. MacKinnon, John R. Marshall, Joseph A. Nuth, III, Brad Werner, and John Wolfe (San Jose State Univ., Calif.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p Previously announced as N86-27139 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

A wide variety of experiments can be conducted on the Space Station that involve the physics of small particles of planetary significance. Processes of interest include nucleation and condensation of particles from a gas, aggregation of small particles into larger ones, and low velocity collisions of particles. All of these processes could be investigated with a general purpose facility on the Space Station. The microgravity environment would be necessary to perform many experiments, as they generally require that particles be suspended for periods substantially longer than are practical at 1 g. Only experiments relevant to planetary processes will be discussed in detail here, but it is important to stress that a particle facility will be useful to a wide variety of scientific disciplines, and can be used to address many scientific problems. Author

**N89-15002*#** Lawrence Livermore National Lab., CA.
**EXPERIMENTAL COSMOCHEMISTRY IN THE SPACE STATION c90**
Al Duba *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

The purpose of two workshops was to identify and discuss experiments in cosmochemistry that cannot be conducted under the conditions available in terrestrial laboratories, but may be carried out successfully in the proposed Space Station. The scientific discussions focused on two general areas of research: chemical and physical processes in the earliest history of the general areas of research, and general principles of magmatic process applicable both to planetary formation and evolution, as well as present-day magmatic activity in and on terrestrial planets. Author

**N89-15003*#** National Aeronautics and Space Administration, Washington, DC.
**REPORT ON OTHER PROPOSALS FOR SSPEX**
Joseph A. Nuth, George J. Corso, Donald DeVincenzi, Al Duba, John W. Freeman, Ramon Lopez, James Stephens, Ian Strong, and John Wolfe (San Jose State Univ., Calif.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 5 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

The only unifying factor among the experiments discussed is that they are all unique Opportunities and/or Techniques for High-caliber Experimental Research (OTHER). Thirteen of the experiments are briefly described. B.G.

**N89-15004*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**AN OVERVIEW OF THE PROGRAM TO PLACE ADVANCED AUTOMATION AND ROBOTICS ON THE SPACE STATION c18**
Richard P. Heydorn *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 6 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22B

The preliminary design phase of the Space Station has uncovered a large number of potential uses of automation and robotics, most of which deal with the assembly and operation of the Station. If NASA were to vigorously push automation and robotics concepts in the design, the Station crew would probably be free to spend a substantial portion of time on payload activities. However, at this point NASA has taken a conservative attitude toward automation and robotics. For example, the belief is that robotics should evolve through telerobotics and that uses of artificial intelligence should be initially used in an advisory capacity. This conservativeness is in part due to the new and untested nature of automation and robotics; but, it is also due to emphases plased on designing the Station to the so-called upfront cost without thoroughly understanding the life cycle cost. Presumably automation and robotics has a tendency to increase the initial cost of the Space Station but could substantially reduce the life cycle cost. To insure that NASA will include some form of robotic capability, Congress directed to set aside funding. While this stimulates the development of robotics, it does not necessarily stimulate uses of artificial intelligence. However, since the initial development costs of some forms of artificial intelligence, such as expert systems, are in general lower than they are for robotics one is likely to see several expert systems being used on the Station. Author

**N89-15005*#** California Inst. of Tech., Pasadena. Seismological Lab.
**A PLANETARY ULTRA HYPERVELOCITY IMPACT MECHANICS AND SHOCK WAVE SCIENCE FACILITY Abstract Only c90**
Thomas J. Ahrens *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p Previously announced as N86-27141 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

Using the concept of intercepting orbits from a pair of Space

Station serviced free flyers, a class of impact and shock wave experiments pertinent to planetary science can be performed. One proposed free flying vehicle is an impactor dispensor, and the second is the impact laboratory. How collision is achieved by utilizing essentially twice orbital velocity is demonstrated. The impactor dispensor contains a series of small flyer plates or other projectiles which are launched into the trajectory of the impactor laboratory at appropriate positions. The impactor laboratory is a large impact tank similar to those in terrestrial gun laboratories, except that it contains a supply of targets and instrumentation such as high speed cameras, flash X-ray apparatus, and digital recorders. Shock and isentropic pressures of up to 20 Mbar are achievable with such a system which provides 15 km/sec impact velocities for precisely oriented projectiles. B.G.

**N89-15006*#** California Inst. of Tech., Pasadena. Seismological Lab. .

**PROPOSED EARTH-BASED CRATERING EXPERIMENTS AT LOW g IN HARD VACUUM Abstract Only** **c29**

Thomas J. Ahrens *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p Previously announced as N86-27142 (For primary document see N89-14998 06-88)

Avail: NTIS HC A09/MF A01 CSCL 22A

In order to address the question of whether the cratering scale which was developed can be extrapolated to low velocity (of planetesimals appropriate for conditions during accretions of planets and the impact mechanics of encounters for both asteroids and the solid objects which comprise the rings of the outer major planets), a series of experiments at low gravity and at high vacuum are proposed. Specific issues which could be addressed include: the effect of very low gravity on cratering efficiency and final crater shape; and the dynamics of impact into a strengthless spherical and ellipsoidal liquid target. Author

**N89-15007*#** Baylor Univ., Waco, TX. Space Science Lab.

**INVESTIGATION OF THE ENHANCED SPATIAL DENSITY OF SUBMICRON LUNAR EJECTA BETWEEN L VALUES 1.2 AND 3.0 IN THE EARTH'S MAGNETOSPHERE: THEORY** **c90**

W. M. Alexander, W. G. Tanner, and H. S. Goad *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 9 p (For primary document see N89-14998 06-88)

Avail: NTIS HC A09/MF A01 CSCL 03B

Initial results from the measurement conducted by the dust particle experiment on the lunar orbiting satellite Lunar Explorer 35 (LE 35) were reported with the data interpreted as indicating that the moon is a significant source of micrometeroids. Primary sporadic and stream meteoroids impacting the surface of the moon at hypervelocity was proposed as the source of micron and submicron particles that leave the lunar craters with velocities sufficient to escape the moon's gravitational sphere of influence. No enhanced flux of lunar ejecta with masses greater than a nanogram was detected by LE 35 or the Lunar Orbiters. Hypervelocity meteoroid simulation experiments concentrating on ejecta production combined with extensive analyses of the orbital dynamics of micron and submicron lunar ejecta in selenocentric, cislunar, and geocentric space have shown that a pulse of these lunar ejecta, with a time correlation relative to the position of the moon relative to the earth, intercepts the earth's magnetopause surface (EMPs). As shown, a strong reason exists for expecting a significant enhancement of submicron dust particles in the region of the magnetosphere between L values of 1.2 and 3.0. This is the basis for the proposal of a series of experiments to investigate the enhancement or even trapping of submicron lunar ejecta in this region. The subsequent interaction of this mass with the upper-lower atmosphere of the earth and possible geophysical effects can then be studied. Author

**N89-15008*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**IMPACT CRATERING IN REDUCED-GRAVITY ENVIRONMENTS: EARLY EXPERIMENTS ON THE NASA KC-135 AIRCRAFT** **c29**

Mark J. Cintala, F. Hoerz, and T. H. See (Lockheed Engineering and Management Services Co., Inc., Houston, TX.) *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)

Avail: NTIS HC A09/MF A01 CSCL 22A

Impact experimentation on the NASA KC-135 Reduced-Gravity Aircraft was shown to be possible, practical, and of considerable potential use in examining the role of gravity on various impact phenomena. With a minimal facility, crater dimensional and growth-times were measured, and have demonstrated both agreement and disagreement with predictions. A larger facility with vacuum capability and a high-velocity gun would permit a much wider range of experimentation. Author

**N89-15009*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

**LOW-GRAVITY IMPACT EXPERIMENTS: PROGRESS TOWARD A FACILITY DEFINITION** **c29**

Mark J. Cintala *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)

Avail: NTIS HC A09/MF A01 CSCL 22A

Innumerable efforts were made to understand the cratering process and its ramifications in terms of planetary observations, during which the experiments both were devoted in many cases to unraveling the contribution of gravitational acceleration to cratering mechanisms. Included among these are the explosion experiments in low-gravity aircraft, the drop-platform experiments, and the high-g centrifuge experiments. Considerable insight into the effects of gravity, among other factors, was gained. Even so, other avenues of investigation were out of reach to workers confined to the terrestrial laboratory. It is in this light that the Space Station is being examined as a vehicle with the potential to support otherwise impractical impact experiments. The results of studies performed by members of the planetary cratering community are summarized; their names and affiliations are listed. Author

**N89-15010*#** Chicago Univ., IL. Dept. of Physics.

**COSMIC DUST COLLECTION WITH A SUB SATELLITE TETHERED TO A SPACE STATION** **c90**

George J. Corso *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p Previously announced as N86-27146 Prepared in cooperation with Northwestern Univ., Evanston, IL (For primary document see N89-14998 06-88)

Avail: NTIS HC A09/MF A01 CSCL 03B

The number concentration and density of 1 micron and submicron sized grains in interplanetary space, as well as their relation to the larger zodical dust particles, and the importance of the beta meteoroid phenomenon are currently being questioned. The best approach to collecting large numbers of intact micron and submicron sized cosmic dust particles in real time while avoiding terrestrial and man made contamination would be to employ a tethered subsatellite from a space station down into the earth's atmosphere. Such a subsatellite tied to the space shuttle by a 100 km long tether is being developed. It is also possible that a permanent space station would allow the use of a tether even longer than 100 km. It should be noted that the same tethered collectors could also be employed to study the composition and flux of man made earth orbiting debris in any direction within 100 km or so of the space station. B.G.

**N89-15011*#** Lawrence Livermore National Lab., CA.

**ELECTRICAL CONDUCTIVITY OF CARBONACEOUS CHONDRITES AND ELECTRIC HEATING OF METEORITE PARENT BODIES** **c90**

Al Duba *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
(Contract W-7405-eng-48)
Avail: NTIS HC A09/MF A01 CSCL 03B

Electromagnetic heating of rock-forming materials most probably was an important process in the early history of the solar system. Electrical conductivity experiments of representative materials such as carbonaceous chondrites are necessary to obtain data for use in electromagnetic heating models. With the assumption that carbon was present at grain boundaries in the material that comprised the meteorite parent bodies, the electrical heating of such bodies was calculated as a function of body size and solar distance using the T-Tauri model of Sonett and Herbert (1977). The results are discussed. Author

**N89-15012*#** Lawrence Livermore National Lab., CA.
**ELECTRICAL CONDUCTIVITY OF CHONDRITIC METEORITES Abstract Only** **c90**
Al Duba, E. M. Didwall, G. J. Burke, and C. P. Sonett (Arizona Univ., Tucson.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
(Contract W-7405-eng-48)
Avail: NTIS HC A09/MF A01 CSCL 03B

The electrical conductivity of samples of the Murchison and Allende carbonaceous chondrites is 4 to 6 orders of magnitude greater than rock forming minerals such as olivine for temperatures up to 700 C. The remarkably high electrical conductivity of these meteorites is attributed to carbon at the grain boundaries. Much of this carbon is produced by pyrolyzation of hydrocarbons at temperatures in excess of 150 C. As the temperature increases, light hydrocarbons are driven off and a carbon-rich residue or char migrates to the grain boundaries enhancing electrical conductivity. Assuming that carbon was present at the grain boundaries in the material which comprised the meteorite parent bodies, the electrical heating of such bodies was calculated as a function of body size and solar distance during a hypothetical T-Tauri phase of the sun. Input conductivity data for the meteorite parent body were the present carbonaceous chondrite values for temperatures up to 840 C and the electrical conductivity values for olivine above 840 C. Author

**N89-15013*#** Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
**THE ORBIT PROPERTIES OF COLLIDING CO-ORBITING BODIES** **c90**
John W. Freeman *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

It is generally assumed that an ensemble of small bodies located in similar Keplarian orbits will, because of collisions, tend to disperse into more and more dissimilar orbits. This theory was challenged. Alfven maintains that for the case where the time between collisions is longer than the orbit period and the collisions are essentially inelastic the orbits and velocities will become more similar. This gives rise to the concepts of negative diffusion and jet streams. It is proposed that this question might be investigated experimentally using the space station. The proposed experiment is briefly described. Author

**N89-15014*#** Texas A&M Univ., College Station. Dept. of Geology.
**VOLATILIZATION-DEVOLATILIZATION REACTIONS** **c25**
M. C. Gilbert, D. M. Anderson, A. Hajash, E. Hoskins, and R. K. Popp *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 07D

Experiments that explore chemical and physical aspects of volatilization reactions that require the microgravity and low pressure in or near the projected Space Station are proposed. Author

**N89-15015*#** National Oceanic and Atmospheric Administration, Boulder, CO.
**SMALL LINEAR WIND TUNNEL SALTATION EXPERIMENTS: SOME EXPERIENCES** **c09**
D. A. Gillette and P. R. Owen (Imperial Coll. of Science and Technology, London, England ) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 14B

Since the wind tunnel proposed to be used for the Space Station Planetology Experiments are of a rather limited size, some experience and techniques used for saltation experiments in a small linear wind tunnel may be of interest. Three experiences are presented. The first concerns a length effect of saltation mass flux in which the size of the wind tunnel exaggerates the physical process taking place. A second experience concerns a non-optical technique that does not interfere with flow and by which momentum and mass fluxes to the flow may be measured. The technique may also be used to calculate saltation flux. The third experience concerns the use of the momentum equation to estimate momentum fluxes by differences. Author

**N89-15016*#** Department of Energy, Mines, and Resources, Ottawa (Ontario). Earth Physics Branch.
**IMPACT EXPERIMENTATION AND THE MICROGRAVITY ENVIRONMENT: AN OVERVIEW** **c29**
Richard A. F. Grieve *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

Impact is an ubiguitous physical process in the solar system. It occurs on all solid bodies and operates over a spectrum of scales. Understanding impact phenomena is therefore paramount in constraining and underpinning a large number of research efforts into fundamental problems in planetary geology. Gravity is an important parameter in impact processes. The advantages of microgravity experimentation are discussed. Author

**N89-15017*#** National Aeronautics and Space Administration, Washington, DC.
**EXOBIOLOGY EXPERIMENT CONCEPTS FOR SPACE STATION Abstract Only** **c51**
Lynn D. Griffiths (Management and Technical Services Co., Washington, DC.) and Donald L. DeVincenzi *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 1 p Previously announced as N86-27152 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 06C

The exobiology discipline uses ground based and space flight resources to conduct a multidiscipline research effort dedicated to understanding fundamental questions about the origin, evolution, and distribution of life and life related molecules throughout the universe. Achievement of this understanding requires a methodical research strategy which traces the history of the biogenic elements from their origins in stellar formation processes through the chemical evolution of molecules essential for life to the origin and evolution of primitive and, ultimately, complex living species. Implementation of this strategy requires the collection and integration of data from solar system exploration spacecraft and ground based and orbiting observatories and laboratories. The Science Lab Module (SLM) of the Space Station orbiting complex may provide an ideal setting in which to perform certain classes of experiments which form the cornerstone of exobiology research. These experiments could demonstrate the pathways and processes by which biomolecules are synthesized under conditions that stimulate the primitive earth, planetary atmospheres, cometary ices,

and interstellar dust grains. Exobiology experiments proposed for the Space Station generally fall into four classes: interactions among gases and grains (nucleation, accretion, gas-grain reactions), high energy chemistry for the production of biomolecules, physical and chemical processes occurring on an artificial comet, and tests of the theory of panspermia. Author

**N89-15018*#** Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
**EXPERIMENTAL STUDIES OF CRYSTAL-MELT DIFFERENTIATION IN PLANETARY BASALT COMPOSITIONS** **c76**
T. L. Grove *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 20L

An important process that controls the evolution of magmas on and within planetary bodies is crystal-melt differentiation. Experimental studies of silicate melt solidification were performed on several planetary and terrestrial melt compositions, and experiments on one of these compositions in the microgravity environment of the space station would provide an opportunity to understand the factors that control crystal growth and crystal-melt exchange processes at crystal-melt interfaces during solidification. Experimental requirements are presented. Author

**N89-15019*#** Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
**KINETICS OF MINERAL CONDENSATION IN THE SOLAR NEBULA Abstract Only** **c92**
T. L. Grove *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

A natural extension of the type of gas-mineral-melt condensation experiments is to study the gas-mineral-melt,reaction process by controlling the reaction times of appropriate gas compositions with silicate materials. In a condensing and vaporizing gas-solid system, important processes that could influence the composition of and speciation in the gas phase are the kinetics of vaporization of components from silicate crystals and melts. The high vacuum attainable in the space station would provide an environment for studying these processes at gas pressures much lower than those obtainable in experimental devices operated at terrestrial conditions in which the gas phase and mineral or melt would be allowed to come to exchange equilibrium. Further experiments would be performed at variable gas flow rates to simulate disequilibrium vapor fractionation. In this type of experiment it is desirable to analyze directly the species in the gas phase in equilibrium with the condensed silicate material. This analytical method would provide a direct determination of the species present in the gas phase. Currently, the notion of gas speciation is based on calculations from thermodynamic data. The proposed experiments require similar furnace designs and use similar experimental starting compositions, pressures, and temperatures as those described by Mysen. Author

**N89-15020*#** Iowa State Univ. of Science and Technology, Ames. Dept. of Aerospace Engineering.
**SEDIMENT-TRANSPORT EXPERIMENTS IN ZERO-GRAVITY** **c29**
James D. Iversen and Ronald Greeley (Arizona State Univ., Tempe.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p Previously announced as N86-27153 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

One of the important parameters in the analysis of sediment entrainment and transport is gravitational attraction. The availability of a laboratory in earth orbit would afford an opportunity to conduct experiments in zero and variable gravity environments. Elimination of gravitational attraction as a factor in such experiments would enable other critical parameters (such as particle cohesion and aerodynamic forces) to be evaluated much more accurately. A Carousel Wind Tunnel (CWT) is proposed for use in conducting experiments concerning sediment particle entrainment and transport in a space station. In order to test the concept of this wind tunnel design a one third scale model CWT was constructed and calibrated. Experiments were conducted in the prototype to determine the feasibility of studying various aeolian processes and the results were compared with various numerical analysis. Several types of experiments appear to be feasible utilizing the proposed apparatus. Author

**N89-15021*#** Arizona State Univ., Tempe.
**DESIGN AND CALIBRATION OF THE CAROUSEL WIND TUNNEL Abstract Only** **c09**
R. N. Leach, Ronald Greeley, James D. Iversen, Bruce R. White (California Univ., Davis.), and John R. Marshall *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p Previously announced as N86-27154 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 14B

In the study of planetary aeolian processes the effect of gravity is not readily modeled. Gravity appears in the equations of particle motion along with interparticle forces but the two terms are not separable. A wind tunnel that would permit variable gravity would allow separation of the forces and aid greatly in understanding planetary aeolian processes. The design of the Carousel Wind Tunnel (CWT) allows for a long flow distance in a small sized tunnel since the test section is a continuous circuit and allows for a variable pseudo-gravity. A prototype design was built and calibrated to gain some understanding of the characteristics of the design and the results presented. B.G.

**N89-15022*#** Arizona State Univ., Tempe.
**DEVELOPMENT AND TESTING OF A UNIQUE CAROUSEL WIND TUNNEL TO EXPERIMENTALLY DETERMINE THE EFFECT OF GRAVITY AND THE INTERPARTICLE FORCE ON THE PHYSICS OF WIND-BLOWN PARTICLES** **c09**
R. N. Leach, Ronald Greeley, Bruce R. White, and James D. Iversen (Iowa State Univ. of Science and Technology, Ames.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 6 p (For primary document see N89-14998 06-88)
(White, Bruce R.) Avail: NTIS HC A09/MF A01 CSCL 14B

In the study of planetary aeolian processes the effect of gravity is not readily modeled. Gravity appears in the equations of particle motion along with the interparticle forces but the two are not separable. A wind tunnel that perimits multiphase flow experiments with wind blown particles at variable gravity was built and experiments were conducted at reduced gravity. The equations of particle motion initiation (saltation threshold) with variable gravity were experimentally verified and the interparticle force was separated. A uniquely design Carousel Wind Tunnel (CWT) allows for the long flow distance in a small sized tunnel since the test section if a continuous loop and develops the required turbulent boundary layer. A prototype model of the tunnel where only the inner drum rotates was built and tested in the KC-135 Weightless Wonder 4 zero-g aircraft. Future work includes further experiments with walnut shell in the KC-135 which sharply graded particles of widely varying median sizes including very small particles to see how interparticle force varies with particle size, and also experiments with other aeolian material. Author

**N89-15023*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**DYNAMIC CRYSTALLIZATION EXPERIMENTS ON CHONDRULE MELTS IN REDUCED GRAVITY** **c29**
Gary Lofgren and R. J. Williams *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

Chondrules crystallized during the earliest formational history of the solar system; and, if crystal settling and flotation are indicators of crystallization in the presence of gravity, they formed without the influence of gravity. In fact, attempts to duplicate the crystallization history of chondrules in the laboratory have met with limited success, because of the difficulty of comparing objects formed under the influence of gravity with objects that did not. These comparisons are difficult because there are several recognized features introduced by the presence of gravity and no doubt some which are not yet recognized. As a result there are several microscale and macroscale aspects of chondrule petrology which are difficult to understand quantitatively. Most of the features relate to the settling or flotation of early formed crystals. The proposed experiments are briefly described. Author

**N89-15024*#** Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.

**A MAGNETOSPHERIC SIMULATION AT THE SPACE STATION Abstract Only** **c90**

R. E. Lopez, John W. Freeman, and F. C. Michel *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 1 p Previously announced as N86-27155 (For primary document see N89-14998 06-88)

Avail: NTIS HC A09/MF A01 CSCL 03B

It is proposed that a strong magnet (terrella) be flown at or near the Space Station to create an artificial magnetosphere in a laboratory setting. The relative flow of the ionosphere past the terrella will constitute a plasma wind that will interact with the magnetic field of the terrella to produce a localized magnetosphere. This object could then be extensively studied using diagnostic probes attached to the Space Station or with free flyers. The space and storage requirements would be minimal, since the experiment would be conducted outside the Space Station. The total equipment would consist of several terrella (with varying surface conductivities), approximately 3 small magnetometer/plasma diagnostic packages, and several gas canisters for upstream seeding. Power requirements would be approximately 60 watts. Several track mounted tethers, each approximately or 200 m long in length, with track parallel to the orbital motion and 100 m long, are also needed. Astronaut time needed would be minimal in the tethered configuration (approximately 4 man hours/week). A free flying configuration, while not needing the tether track, would require much more human interaction. Author

**N89-15025*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX. Dept. of Geology.

**KINETICS IN A TURBULENT NEBULAR CLOUD** **c90**

Ian D. R. MacKinnon (New Mexico Univ., Albuquerque.) and F. J. M. Rietmeijer *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)

Avail: NTIS HC A09/MF A01 CSCL 03B

Model calculations, which include the effects of turbulence during subsequent solar nebula evolution after the collapse of a cool interstellar cloud, can reconcile some of the apparent differences between physical parameters obtained from theory and the cosmochemical record. Two important aspects of turbulence in a protoplanetary cloud include the growth and transport of solid grains. While the physical effects of the process can be calculated and compared with the probable remains of the nebula formulation period, the more subtle effects on primitive grains and their survival in the cosmochemical record cannot be readily evaluated. The environment offered by the Space Station (or Space Shuttle) experimental facility can provide the vacuum and low gravity conditions for sufficiently long time periods required for experimental verification of these cosmochemical models. Author

**N89-15026*#** Arizona State Univ., Tempe. Dept. of Geology.

**CAUTIONARY TALES FOR REDUCED-GRAVITY PARTICLE RESEARCH** **c29**

John R. Marshall, Ronald Greeley, and D. W. Tucker *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)

Avail: NTIS HC A09/MF A01 CSCL 22A

Failure of experiments conducted on the KC-135 aircraft in zero gravity are discussed. Tests that were a total failure are reported. Why the failure occurred and the sort of questions that potential researchers should ask in order to avoid the appearance of abstracts such as this are discussed. Many types of aggregation studies were proposed for the Space Station, and it is hoped that the following synopsis of events will add a touch of reality to experimentation proposed for this zero-gravity environment. Author

**N89-15027*#** Arizona State Univ., Tempe. Dept. of Geology.

**ELECTROSTATIC AGGREGATION OF FINELY-COMMINUTED GEOLOGICAL MATERIALS** **c46**

John R. Marshall and Ronald Greeley *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p Previously announced as N86-27156 (For primary document see N89-14998 06-88)

Avail: NTIS HC A09/MF A01 CSCL 08G

Electrostatic forces are known to have a significant effect on the behavior of finely comminuted particulate material: perhaps the most prevalent expression of this being electrostatic aggregation of particles into relatively coherent clumps. However, the precise role of electrostatic attraction and repulsion in determining the behavior of geological materials (such as volcanic ash and aeolian dust) is poorly understood. Electrostatic aggregation of fine particles is difficult to study on earth either in the geological or laboratory environment principally because the material in an aggregated state remains airborne for such a short period of time. Experiments conducted in the NASA/JSC - KC135 aircraft are discussed. The aircraft experiments are seen as precursors to more elaborate and scientifically more comprehensive Shuttle or Space Station activities. B.G.

**N89-15028*#** Carnegie Institution of Washington, DC. Geophysical Lab.

**CRYSTAL-LIQUID-VAPOR EQUILIBRIUM EXPERIMENTS AT HIGH TEMPERATURE (LESS THAN OR EQUAL TO 1800 C) AND LOW, CONTROLLED OXYGEN AND HYDROGEN PRESSURE (10(-1) TO 10(-9) PA)** **c25**

B. O. Mysen *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p (For primary document see N89-14998 06-88)

Avail: NTIS HC A09/MF A01 CSCL 07D

Evidence from carbonaceous chrondrites points to refractory oxides in the system CaO-MgO-Al2O3-TiO2-SiO2-Fe-O as being among the earliest phases to condense from the solar nebula. It is necessary to establish the equilibrium relationships between the relevant crystalline and amorphous phases before the chemical constraints can be meaningfully applied to models of solar system history. Preliminary experiments on earth show that such experiments are feasible. Earth-based experiments suffer from several unavoidable problems. These problems can be overcome by experimentation in the Space Station where the experiments can be conducted under near static pressure conditions and where total pressure equals the sum of controlled hydrogen and oxygen pressures and can be controlled for periods exceeding several hours. Author

**N89-15029*#** Guelph Univ. (Ontario).

**THE INITIATION OF GRAIN MOVEMENT BY WIND** **c46**

William G. Nickling *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space

Station Nov. 1987 2 p Previously announced as N86-27157 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 04A

When air blows across the surface of dry, loose sand, a critical shear velocity must be achieved to initiate motion. Since most natural sediments consist of a range of grain sizes, fluid threshold for any sediment cannot really be defined by a finite value but should be viewed as a threshold range which is a function of the mean size, sorting, and packing of the sediment. In order to investigate the initiation of particle movement by wind, a series of wind tunnel tests were carried out on a range of screened sands and commercially available glass beads of differing size, sorting, and shape characteristics. In addition, individual samples of the glass beads were mixed to produce rather poorly sorted bimodal distributions. Test results suggest the when velocity is slowly increased over the sediment surface the smaller or more exposed grains are first engrained by the fluid drag of the air either in surface creep or in saltation. As velocity continues to rise, the larger more protected grains may also be moved by fluid drag. The data also indicate that predicted values based on the modified Bagnold equation fall within the range of threshold values defined by the transition section of the grain movement/shear velocity plots. Moreover, the predicted values are very similar to the threshold values derived for the point maximum inflection on the curves. Author

**N89-15030*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**NUCLEATION AND PARTICLE COAGULATION EXPERIMENTS IN MICROGRAVITY c29**
J. Nuth *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

Measurements of the conditions under which carbon, aluminum oxide, and silicon carbide smokes condense and of the morphology and crystal structure of the resulting grains are essential if the nature of the materials ejected into the interstellar medium and the nature of the grains which eventually became part of the proto solar nebular are to be understood. Little information is currently available on the vapor-solid phase transitions of refractory metals and solids. What little experimental data do exist are, however, not in agreement with currently accepted models of the nucleation process for more volatile materials. The major obstacle to performing such experiments in earth-based laboratories is the susceptibility of these systems to convection. Evaporation of refractory materials into a low-pressure environment with a carefully controlled temperature gradient will produce refractory smokes when the critical supersaturation of the system is exceeded. Measurement of the point at which nucleation occurs, via light scattering or extinction, can not only yield nucleation data but also, information on the chemical composition and crystal structure of the condensate. Experimental requirements are presented. Author

**N89-15031*#** National Aeronautics and Space Administration, Washington, DC.
**ULTRAVIOLET SPECTROSCOPY OF METEORIC DEBRIS: IN SITU CALIBRATION EXPERIMENTS FROM EARTH ORBIT c25**
Joseph A. Nuth, Thomas J. Wdowiak, and William R. Kubinec (Charleston Coll., SC.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p Previously announced as N86-27159 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 07D

It is proposed to carry out slitless spectroscopy at ultraviolet wavelengths from orbit of meteoric debris associated with comets. The Eta Aquarid, Orionid/Halley, and the Persied/1962 862 Swift-Tuttle showers would be principal targets. Low light level, ultraviolet video technique will be used during the night side of the orbit in a wide field, earthward viewing mode. Data will be stored in compact video cassette recorders. The experiment may be configured as a GAS package or in the HITCHHIKER mode. The latter would allow flexible pointing capability beyond that offered by shuttle orientation of the GAS package, and doubling of the data record. The 1100 to 3200 A spectral region should show emissions of atomic, ionic, and molecular species of interest on cometary and solar system studies. Author

**N89-15032*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**LOW-GRAVITY FACILITIES FOR SPACE STATION PLANETOLOGY EXPERIMENTS c29**
Paul A. Penzo *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p Previously announced as N86-27160 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

For experimentation, space offers an environment which is unobtainable on earth. One characteristic is a gravity force less than 1 g, where g is the mean earth gravity acceleration of 9.8 m/sq s. The production of uniform gravity levels above zero g in space is discussed in relationship to experimental needs. For planetology experiments, providing gravity in space will make it possible to more nearly simulate conditions on natural bodies. The g-level is but one parameter involved in the design of a specific experiment. Other requirements may be: g-level range; g-level tolerance value; Coriolis tolerance value; volume requirement g-level duration; power and materials for the experiment; and automated or man-tended operations. These requirements, and certainly others, will dictate the type of facility which should be considered. The use of the Space Station of the Tethered Satellite System configurations is discussed. B.G.

**N89-15033*#** Brown Univ., Providence, RI. Dept. of Geological Sciences.
**DEBRIS-CLOUD COLLISIONS: ACCRETION STUDIES IN THE SPACE STATION c90**
Peter H. Schultz and D. E. Gault (Murphys Center of Planetology, CA.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

The growth of planetesimals in the Solar System reflects the success of collisional aggregation over disruption. It is widely assumed that aggregation must represent relatively low encounter velocities between two particles in order to avoid both disruption and high-ejecta velocities. Such an assumption is supported by impact, experiments and theory. Experiments involving particle-particle impacts, however, may be pertinent to only one type of collisional process in the early Solar System. Most models envision a complex protoplanetary nebular setting involving gas and dust. Consequently, collisions between clouds of dust or solids and dust may be a more relistic picture of protoplanetary accretion. Recent experiments performed at the NASA-Ames Vertical Gun Range have produced debris clouds impacting particulate targets with velocities ranging from 100 m/s to 6 km/s. The experiments produced several intriguing results that not only warrant further study but also may encourage experiments with the impact conditions permitted in a microgravity environment. Possible Space Station experiments are briefly discussed. Author

**N89-15034*#** Brown Univ., Providence, RI. Dept. of Geological Sciences.
**IMPACTS OF FREE-FLOATING OBJECTS: UNIQUE SPACE STATION EXPERIMENTS c90**
Peter H. Schultz and D. E. Gault (Murphys Center of Planetology, CA.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

The transfer of momentum and kinetic energy between planetary bodies forms the basis for wide-ranging problems in planetary science ranging from the collective long-term effects of minor perturbations to the catastrophic singular effect of a major collision.

In the former case, the evolution of asteroid spin rates and orientations and planetary rotation rates are cited. In the latter case, the catastrophic angular momenta and the near-global disruption of partially molten planets are included. Although the collisional transfer of momentum and energy were discussed over the last two decades, major issues remain that largely reflect current limitations in earth-based experimental conditions and 3-D numerical codes. Two examples with potential applications in a Space Station laboratory are presented. Author

**N89-15035*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**HOW TO MAKE A COMET c90**
James Stephens, R. Stephen Saunders, and Fraser Fanale (Hawaii Univ., Honolulu.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

The primary mandate of NASA is the study of the nature and origin of the solar system. The study of the comets provide information about conditions and processes at the beginning of the solar system. Short period comets and their relatives, the near Earth asteroids may prove to be second only to the sun in importance to the long term survival of civilization for two reasons. The short period comets and the near Earth asteroids are a possible candidate for the cause of mass extinctions of life on Earth; and they may provide the material means for the expansion of civilization into the solar system and beyond. The comets and near Earth asteroids almost certainly represent the most primitive material of the solar system, still tantalizingly unavailable until spacecraft bring first-hand information. In the meantime comets must be studied by remote means. Laboratory investigations using synthetic cometary materials may add to the knowledge of these interesting objects. Experimentation on comet synthesis is briefly discussed. Author

**N89-15036*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**VOLATILIZATION-FRACTIONATION OF SILICATES RELATED TO CHONDRITE COMPOSITION c90**
L. S. Walter *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

The compositions of chondritic meteorites are linked to the solar composition. It is believed that the chemistry of the (generally) drop-shaped chondrules which comprise a large portion of these meteorites may present valuable clues to their formation and, ultimately, to the early conditions and processes of the planets. The purpose of this experiment is to determine the nature of volatilization-fractionation of silicate (and related metallic) compositions related to chondrite composition. Author

**N89-15037*#** Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Geology.
**TEXTURAL EVOLUTION OF PARTIALLY-MOLTEN PLANETARY MATERIALS IN MICROGRAVITY c29**
E. B. Watson *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

Recent Earth-based experiments examining the textural evolution of partially-molten rocks have revealed two important ways in which surface energy considerations affect magma. An initial experimental program addressing surface-energy effects on partially-molten materials in microgravity would involve simple, isothermal treatment of natural samples (meteorites, perioditic komatiite) at preselected temperatures in the melting range. Textural evolution would be assessed by time studies in which the only experiment variable would be run duration. Textural characterization of each sample would be done by quenching, recover, and sectioning for generally later, computer-aided interpretation of features. Author

**N89-15038*#** California Inst. of Tech., Pasadena. Div. of Physics, Mathematics, and Astronomy.
**GRAIN DYNAMICS IN ZERO GRAVITY c29**
B. T. Werner and P. K. Haff *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

The dynamics of granular materials has proved difficult to model, primarily because of the complications arising from inelastic losses, friction, packing, and the effect of many grains being in contact simultaneously. One interesting limit for which it was recently possible to construct a theory is that where the grain-grain interactions are dominated by binary collisions. The kinetic model of granular systems if similar to the kinetic theory of gases, except that collisional energy losses are always present in the former and must be treated explicitly. Few granular materials on Earth are describable by this limiting model, since gravity tends to collapse the grains into a high-density state where Coulombic friction effects are dominant. The planned Space Station offers an unusual opportunity to test the kinetic grain model and to explore its predictions. Without gravity, the regime of low interparticle velocities, where an elastic description of the collision is still valid, is investigated. This will allow direct interpretation by dynamical computer simulations as well as by kinetic theory. Author

**N89-15039*#** California Univ., Davis.
**AEOLIAN PROCESSES ABOARD A SPACE STATION: SALTATION AND PARTICLE TRAJECTORY ANALYSIS c09**
Bruce R. White, Ronald Greeley, James D. Iversen, and R. N. Leach (Santa Clara Univ., Calif.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p Previously announced a N86-27165 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 14B

The Carousel Wind Tunnel (CWT) proposed to study aeolian processes aboard a Space Station consists of two concentric rotating drums. The space between the two drums comprises the wind tunnel section. Differential rates of rotation of the two drums would provide a wind velocity with respect to either drum surface. Preliminary results of measured velocity profiles made in a CWT prototype indicate that the wall bounded boundary layer profiles are suitable to simuate flat plate turbulent boundary layer flow. The two dimensional flate plate Cartesian coordinate equations of motion of a particle moving through the air are explained. In order to assess the suitability of CWT in the analysis of the trajectories of windblown particles, a series of calculations were conducted comparing cases for gravity with those of zero gravity. Results from the calculations demonstrate that a wind tunnel of the carousel design could be fabricated to operate in a space station environment and that experiments could be conducted which would yield significant results contributing to the understanding of the physics of particle dynamics. B.G.

**N89-15040*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**A SYSTEM FOR CONDUCTING IGNEOUS PETROLOGY EXPERIMENTS UNDER CONTROLLED REDOX CONDITIONS IN REDUCED GRAVITY c29**
Richard J. Williams *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p Previously announced as N86-27166 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

The Space Shuttle and the planned Space Station will permit experimentation under conditions of reduced gravitational acceleration offering experimental petrologists the opportunity to study crystal growth, element distribution, and phase chemistry. In

particular the confounding effects of macro and micro scale buoyancy-induced convection and crystal settling or flotation can be greatly reduced over those observed in experiments in the terrestrial laboratory. Also, for experiments in which detailed replication of the environment is important, the access to reduced gravity will permit a more complete simulation of processes that may have occurred on asteroids or in free space. A technique that was developed to control, measure, and manipulate oxygen fugacities with small quantities of gas which are recirculated over the sample. This system could be adaptable to reduced gravity space experiments requiring redox control. B.G.

**N89-15041*#** San Jose State Univ., Calif.
**NEW TECHNIQUES FOR THE DETECTION AND CAPTURE OF MICROMETEOROIDS Abstract Only** **c90**
J. H. Wolfe *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 1 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

In order to understand the origin and distribution of the biogenic elements and their compounds in the solar system, it will be necessary to study materials from many classes of objects. Chemical, elemental, and isotopic measurements of returned samples of comets, asteroids, and possibly extra-solar system dust clouds would provide information on a particularly important class: primitive objects. Extraterrestrial micron-sized particles in the vicinity of Earth are one source of such materials that might otherwise be inaccessible. The Space Station appears to be an eminently suitable platform from which to collect and detect these various particles. The primary challenge, however, is to collect intact, uncontaminated particles which will be encountered at tens of kilometers per seconds. A concept for a micrometeoroid detector that could be deployed from the Space Station was developed which uses a large area detector plate implanted with acoustic transducers. When an impact event occurs, the resulting signal is subjected to spectral analysis providing positive detection, momentum information, and angle of incidence. The primary advantage of this detector is the large area which increases the probability of measuring events. A concept of a nondestuctive micrometeoroid collector for use from a Space Station was also developed. The collector utilizes input port charging of the incoming particle followed by staged high voltage deceleration for nondestructive capture. Low velocity particles (local contamination) would be rejected due to insufficient energy and only uncontaminated micrometeoroids would be collected. Author

**N89-15042*#** Arizona Univ., Tucson.
**EXPERIMENTAL CONSTRAINTS ON HEATING AND COOLING RATES OF REFRACTORY INCLUSIONS IN THE EARLY SOLAR SYSTEM Abstract Only** **c90**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 1 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

The refractory inclusions in carbonaceous chondrites were the subject of considerable interest since their discovery. These inclusions contain minerals that are predicted to be some of the earliest condensates from the solar nebula, and contain a plethora of isotopic anomalies of unknown origin. Of particular interest are those coarse-grained inclusions that contain refractory metal particles (Fe, Ni, Pt, Ru, Os Ir). Experimental studies of these inclusions in terrestrial laboratories are, however, complicated because the dense particles tend to settle out of a molten or partially molten silicate material. Heating experiments in the Space Station technology and microgravity in order to observe the effects of metal nuggets (which may act as heterogeneous nucleation sites) on nucleation rates in silicate systems and to measure simultaneously the relative volatilization rate of siderophile and lithophile species. Neither experiment is possible in the terrestrial environment. Author

**N89-15043*#** Arizona Univ., Tucson. Dept. of Planetary Sciences, Lunar and Planetary Lab.
**EXPERIMENTAL CONSTRAINTS ON THE ORIGIN OF CHONDRULES Abstract Only** **c90**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

Chrondule formation was an important (perhaps ubiguitous) process in the early solar system, yet their origins remain elusive. Some points, however, are clear. The precursor material of chondules (dust) was rapidly heated at rates of perhaps thousands of degrees per second and was cooled more slowly. It was proposed to investigate chondrule formation in the Space Station environment via a dust-box (a chamber in which dust can be suspended, heated, and cooled. A microgravity environment is conducive to this kind of experiment because of the significant retardation of settling rates compared with a terrestrial laboratory environment. These long-duration experiments might require the development of technologies to counteract even the small, but finite and permanent gravitation field of the Space Station. Simple, but interesting experiments on dust suspensions immediately present themselves. Author

**N89-15044*#** Arizona Univ., Tucson. Dept. of Planetary Sciences.
**EXPERIMENTAL CORRELATION OF MELT STRUCTURES, NUCLEATION RATES, AND THERMAL HISTORIES OF SILICATE MELTS Abstract Only** **c25**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 07D

The theory and measurement of the structure of liquids is an important aspect of modern metallurgy and igneous petrology. Liquid structure exerts strong controls on both the types of crystals that may precipitate from melts and on the chemical composition of those crystals. An interesting aspect of melt structure studies is the problem of melt memories; that is, a melt can retain a memory of previous thermal history. This memory can influence both nucleation behavior and crystal composition. This melt memory may be characterized quantitatively with techniques such as Raman, infrared and NMR spectroscopy to provide information on short-range structure. Melt structure studies at high temperature will take advantage of the microgravity conditions of the Space Station to perform containerless experiments. Melt structure determinations at high temperature (experiments that are greatly facilitated by containerless technology) will provide invaluable information for materials science, glass technology, and geochemistry. In conjunction with studies of nucleation behavior and nucleation rates, information relevant to nucleation in magma chambers in terrestrial planets will be acquired. Author

**N89-15045*#** Arizona Univ., Tucson. Dept. of Planetary Sciences.
**CONTAINERLESS HIGH-PRESSURE PETROLOGY EXPERIMENTS IN THE MICROGRAVITY ENVIRONMENT OF THE SPACE STATION Abstract Only** **c29**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

The genesis of igneous rocks on terrestrial planets can only be understood through experiments at pressures corresponding to those in planetary mantles (10 to 50 kbar). Such experiments typically require a piston-cylinder apparatus, and an apparatus that has the advantage of controllable pressure and temperature,

adequate sample volume, rapid sample quench, and minimal danger of catastrophic failure. It is proposed to perform high-pressure and high-temperature piston-cylinder experiments aboard the Space Station. The microgravity environment in the Space Station will minimize settling due to density contrasts and may, thus, allow experiments of moderate duration to be performed without a platinoid capsule and without the sample having to touch the container walls. The ideal pressure medium would have the same temperatures. It is emphasized, however, that this proposed experimental capability requires technological advances and innovations not currently available. Author

**N89-15046*#** Geological Survey, Flagstaff, AZ.
**MAPPING EXPERIMENT WITH SPACE STATION Abstract Only c43**
Sherman S. C. Wu *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 08B

Mapping the earth from space stations can be approached in two areas. One is to collect gravity data for defining a new topographic datum using the earth's gravitational field in terms of spherical harmonics. The other, which should be considered as a very significant contribution of the Space Station, is to search and explore techniques of mapping the earth's topography using either optical or radar images with or without references to ground control points. Geodetic position of ground control points can be predetermined by the Global Positioning System (GPS) for the mapping experiment with the Space Station. It is proposed to establish four ground control points in North America or Africa (including the Sahara Desert). If this experiment should be successfully accomplished, it may also be applied to the defense charting service. Author

**N89-15047*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**MICROGRAVITY RESEARCH IN NASA GROUND-BASED FACILITIES**
Jack Lekan 1989 17 p Presented at the 27th Aerospace Sciences Meeting, Reno, NV, 9-12 Jan. 1989; sponsored by AIAA (NASA-TM-101397; E-4477; NAS 1.15:101397; AIAA-89-0236)
Avail: NTIS HC A03/MF A01 CSCL 22A

An overview of reduced gravity research performed in NASA ground-based facilities sponsored by the Microgravity Science and Applications Program of the NASA Office of Space Science and Applications is presented. A brief description and summary of the operations and capabilities of each of these facilities along with an overview of the historical usage of them is included. The goals and program elements of the Microgravity Science and Applications programs are described and the specific programs that utilize the low gravity facilities are identified. Results from two particular investigations in combustion (flame spread over solid fuels) and fluid physics (gas-liquid flows at microgravity conditions) are presented. Author

# 89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

**N89-15048** Edinburgh Univ. (Scotland).
**MULTI-OBJECT ASTRONOMICAL SPECTROSCOPY WITH OPTICAL FIBRES Ph.D. Thesis**
Frederick Garnett Watson 1987 355 p
Avail: Univ. Microfilms Order No. BRD-81039

A full account is given of the relatively new astronomical technique of multi-object spectroscopy with optical fiber lightguides. A survey of the number densities of a wide range of astronomical object classes if presented, and after comparing the merits of the various techniques for multi-object spectroscopy, shows that the multi-fiber technique is very well-suited to the real distribution of celestial objects. The properties of optical fibers are reviewed, together with important considerations in the design of fiber feeds for astronomy. This is followed by a description of the requirements in the design of telescopes, spectrographs, and detectors to render them suitable for the multi-fiber technique. Equations are derived for the performance of these systems in terms of signal-to-noise ratio, and an example is given. A survey of the equipment that was built for multi-fiber spectroscopy at observatories throughout the world is presented, and special attention is paid to the FOCAP fiber system at the 3.9 m Anglo-Australian telescope. A description is then given of the FLAIR wide-field fiber-coupled multi-object spectroscopy system for the 1.2 m UK Schmidt Telescope. Reports are presented on a series of observational programming designed to test the system, including the classification of stars in the Chamaeleon dark cloud, spectroscopy of Orion cluster flare stars, spectroscopy of objects in the Large Magellanic Cloud, the measurement of galactic redshifts, and the observation of quasar candidates. An experiment in time-resolved multi-object photometry is also described. Dissert. Abstr.

**N89-15049** California Univ., Santa Cruz.
**OPTICAL SPECTROSCOPY OF X-RAY: SELECTED ACTIVE GALACTIC NUCLEI Ph.D. Thesis**
Sally Anne Stephens 1987 127 p
Avail: Univ. Microfilms Order No. DA8810869

Optical spectra of 65 X-ray selected active galactic nuclei (XAGN) from several identification samples are presented. From analysis of their spectra and optical continuum luminosities, the XAGN are classified as follows: 13 quasars, 10 narrow line Seyfert 1 galaxies, 3 Seyfert 1.5's, 3 Seyfert 2's, 1 Seyfert 1.9, 1 HII region-like galaxy and 3 galaxies with very weak emission. The rest are most likely Seyfert 1 galaxies. X-ray selection seems to be an efficient way to find narrow line Seyfert galaxies. One possible explanation is if some or all narrow line Seyfert 1's are pole-on Seyfert 2 galaxies. In this picture, the material that obscures the broad line region of Seyfert 2 galaxies is in a disk that is optically thick to X-rays. Viewed edge-on, it looks like a Seyfert 2. But viewed from above the pole, X-rays can escape, the featureless continuum will be less obscured and FeII emission might be visible. All these features are associated with narrow line Seyfert 1's. A possible spectral discriminant between quasars and Seyfert 1 galaxies was seen. Dissert. Abstr.

# 90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

For related information see also *75 Plasma Physics.*

**N89-15050** Harvard Univ., Cambridge, MA.
**LINEAR CLUSTERS OF GALAXIES Ph.D. Thesis**
Giles Nicholas Fenge Chapman 1987 208 p
Avail: Univ. Microfilms Order No. DA8806068

Linear clusters may impose constraints on cluster evolution and formation models. New data and analytical methods are presented. Three clusters (A194, A999, and A1016) which were classified as linear by Rood and Sastry (1971) were studied. Using galaxy positions and redshifts, cluster membership was assigned. A measure of linearity was devised and a value was obtained for each cluster and for 120 spherically symmetric models. The standard virial mass estimator assumes isotropy and is not appropriate for flattened clusters. The statistical method used to search for galaxy alignments were reassessed and a nonparametric test was proposed. No evidence was found for alignment in the convincingly linear systems (A194 and A1060). All three clusters were tested for luminosity segregation and for variations in the velocity or surface distributions of galaxies as a function of morphological type. Neither the heirarchical clustering model nor the pancake model straightforwardly produce systems with the physical properties of A194. It was suggested that the cluster may be a portion of a shell-like structure similar to those seen in the Center for Astrophysics redshift survey. Dissert. Abstr.

particular the confounding effects of macro and micro scale buoyancy-induced convection and crystal settling or flotation can be greatly reduced over those observed in experiments in the terrestrial laboratory. Also, for experiments in which detailed replication of the environment is important, the access to reduced gravity will permit a more complete simulation of processes that may have occurred on asteroids or in free space. A technique that was developed to control, measure, and manipulate oxygen fugacities with small quantities of gas which are recirculated over the sample. This system could be adaptable to reduced gravity space experiments requiring redox control. B.G.

**N89-15041*#** San Jose State Univ., Calif.
**NEW TECHNIQUES FOR THE DETECTION AND CAPTURE OF MICROMETEOROIDS Abstract Only** **c90**
J. H. Wolfe *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 1 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

In order to understand the origin and distribution of the biogenic elements and their compounds in the solar system, it will be necessary to study materials from many classes of objects. Chemical, elemental, and isotopic measurements of returned samples of comets, asteroids, and possibly extra-solar system dust clouds would provide information on a particularly important class: primitive objects. Extraterrestrial micron-sized particles in the vicinity of Earth are one source of such materials that might otherwise be inaccessible. The Space Station appears to be an eminently suitable platform from which to collect and detect these various particles. The primary challenge, however, is to collect intact, uncontaminated particles which will be encountered at tens of kilometers per seconds. A concept for a micrometeoroid detector that could be deployed from the Space Station was developed which uses a large area detector plate implanted with acoustic transducers. When an impact event occurs, the resulting signal is subjected to spectral analysis providing positive detection, momentum information, and angle of incidence. The primary advantage of this detector is the large area which increases the probability of measuring events. A concept of a nondestuctive micrometeoroid collector for use from a Space Station was also developed. The collector utilizes input port charging of the incoming particle followed by staged high voltage deceleration for nondestructive capture. Low velocity particles (local contamination) would be rejected due to insufficient energy and only uncontaminated micrometeoroids would be collected. Author

**N89-15042*#** Arizona Univ., Tucson.
**EXPERIMENTAL CONSTRAINTS ON HEATING AND COOLING RATES OF REFRACTORY INCLUSIONS IN THE EARLY SOLAR SYSTEM Abstract Only** **c90**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 1 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

The refractory inclusions in carbonaceous chondrites were the subject of considerable interest since their discovery. These inclusions contain minerals that are predicted to be some of the earliest condensates from the solar nebula, and contain a plethora of isotopic anomalies of unknown origin. Of particular interest are those coarse-grained inclusions that contain refractory metal particles (Fe, Ni, Pt, Ru, Os Ir). Experimental studies of these inclusions in terrestrial laboratories are, however, complicated because the dense particles tend to settle out of a molten or partially molten silicate material. Heating experiments in the Space Station technology and microgravity in order to observe the effects of metal nuggets (which may act as heterogeneous nucleation sites) on nucleation rates in silicate systems and to measure simultaneously the relative volatilization rate of siderophile and lithophile species. Neither experiment is possible in the terrestrial environment. Author

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**EXPERIMENTAL CONSTRAINTS ON THE ORIGIN OF CHONDRULES Abstract Only** **c90**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
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**N89-15044*#** Arizona Univ., Tucson. Dept. of Planetary Sciences.
**EXPERIMENTAL CORRELATION OF MELT STRUCTURES, NUCLEATION RATES, AND THERMAL HISTORIES OF SILICATE MELTS Abstract Only** **c25**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 07D

The theory and measurement of the structure of liquids is an important aspect of modern metallurgy and igneous petrology. Liquid structure exerts strong controls on both the types of crystals that may precipitate from melts and on the chemical composition of those crystals. An interesting aspect of melt structure studies is the problem of melt memories; that is, a melt can retain a memory of previous thermal history. This memory can influence both nucleation behavior and crystal composition. This melt memory may be characterized quantitatively with techniques such as Raman, infrared and NMR spectroscopy to provide information on short-range structure. Melt structure studies at high temperature will take advantage of the microgravity conditions of the Space Station to perform containerless experiments. Melt structure determinations at high temperature (experiments that are greatly facilitated by containerless technology) will provide invaluable information for materials science, glass technology, and geochemistry. In conjunction with studies of nucleation behavior and nucleation rates, information relevant to nucleation in magma chambers in terrestrial planets will be acquired. Author

**N89-15045*#** Arizona Univ., Tucson. Dept. of Planetary Sciences.
**CONTAINERLESS HIGH-PRESSURE PETROLOGY EXPERIMENTS IN THE MICROGRAVITY ENVIRONMENT OF THE SPACE STATION Abstract Only** **c29**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 22A

The genesis of igneous rocks on terrestrial planets can only be understood through experiments at pressures corresponding to those in planetary mantles (10 to 50 kbar). Such experiments typically require a piston-cylinder apparatus, and an apparatus that has the advantage of controllable pressure and temperature,

adequate sample volume, rapid sample quench, and minimal danger of catastrophic failure. It is proposed to perform high-pressure and high-temperature piston-cylinder experiments aboard the Space Station. The microgravity environment in the Space Station will minimize settling due to density contrasts and may, thus, allow experiments of moderate duration to be performed without a platinoid capsule and without the sample having to touch the container walls. The ideal pressure medium would have the same temperatures. It is emphasized, however, that this proposed experimental capability requires technological advances and innovations not currently available. Author

**N89-15046*#** Geological Survey, Flagstaff, AZ.
**MAPPING EXPERIMENT WITH SPACE STATION Abstract Only c43**
Sherman S. C. Wu *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 08B

Mapping the earth from space stations can be approached in two areas. One is to collect gravity data for defining a new topographic datum using the earth's gravitational field in terms of spherical harmonics. The other, which should be considered as a very significant contribution of the Space Station, is to search and explore techniques of mapping the earth's topography using either optical or radar images with or without references to ground control points. Geodetic position of ground control points can be predetermined by the Global Positioning System (GPS) for the mapping experiment with the Space Station. It is proposed to establish four ground control points in North America or Africa (including the Sahara Desert). If this experiment should be successfully accomplished, it may also be applied to the defense charting service. Author

**N89-15047*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**MICROGRAVITY RESEARCH IN NASA GROUND-BASED FACILITIES**
Jack Lekan 1989 17 p Presented at the 27th Aerospace Sciences Meeting, Reno, NV, 9-12 Jan. 1989; sponsored by AIAA (NASA-TM-101397; E-4477; NAS 1.15:101397; AIAA-89-0236)
Avail: NTIS HC A03/MF A01 CSCL 22A

An overview of reduced gravity research performed in NASA ground-based facilities sponsored by the Microgravity Science and Applications Program of the NASA Office of Space Science and Applications is presented. A brief description and summary of the operations and capabilities of each of these facilities along with an overview of the historical usage of them is included. The goals and program elements of the Microgravity Science and Applications programs are described and the specific programs that utilize the low gravity facilities are identified. Results from two particular investigations in combustion (flame spread over solid fuels) and fluid physics (gas-liquid flows at microgravity conditions) are presented. Author

# 89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

**N89-15048** Edinburgh Univ. (Scotland).
**MULTI-OBJECT ASTRONOMICAL SPECTROSCOPY WITH OPTICAL FIBRES Ph.D. Thesis**
Frederick Garnett Watson 1987 355 p
Avail: Univ. Microfilms Order No. BRD-81039

A full account is given of the relatively new astronomical technique of multi-object spectroscopy with optical fiber lightguides. A survey of the number densities of a wide range of astronomical object classes if presented, and after comparing the merits of the various techniques for multi-object spectroscopy, shows that the multi-fiber technique is very well-suited to the real distribution of celestial objects. The properties of optical fibers are reviewed, together with important considerations in the design of fiber feeds for astronomy. This is followed by a description of the requirements in the design of telescopes, spectrographs, and detectors to render them suitable for the multi-fiber technique. Equations are derived for the performance of these systems in terms of signal-to-noise ratio, and an example is given. A survey of the equipment that was built for multi-fiber spectroscopy at observatories throughout the world is presented, and special attention is paid to the FOCAP fiber system at the 3.9 m Anglo-Australian telescope. A description is then given of the FLAIR wide-field fiber-coupled multi-object spectroscopy system for the 1.2 m UK Schmidt Telescope. Reports are presented on a series of observational programming designed to test the system, including the classification of stars in the Chamaeleon dark cloud, spectroscopy of Orion cluster flare stars, spectroscopy of objects in the Large Magellanic Cloud, the measurement of galactic redshifts, and the observation of quasar candidates. An experiment in time-resolved multi-object photometry is also described. Dissert. Abstr.

**N89-15049** California Univ., Santa Cruz.
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Sally Anne Stephens 1987 127 p
Avail: Univ. Microfilms Order No. DA8810869

Optical spectra of 65 X-ray selected active galactic nuclei (XAGN) from several identification samples are presented. From analysis of their spectra and optical continuum luminosities, the XAGN are classified as follows: 13 quasars, 10 narrow line Seyfert 1 galaxies, 3 Seyfert 1.5's, 3 Seyfert 2's, 1 Seyfert 1.9, 1 HII region-like galaxy and 3 galaxies with very weak emission. The rest are most likely Seyfert 1 galaxies. X-ray selection seems to be an efficient way to find narrow line Seyfert galaxies. One possible explanation is if some or all narrow line Seyfert 1's are pole-on Seyfert 2 galaxies. In this picture, the material that obscures the broad line region of Seyfert 2 galaxies is in a disk that is optically thick to X-rays. Viewed edge-on, it looks like a Seyfert 2. But viewed from above the pole, X-rays can escape, the featureless continuum will be less obscured and FeII emission might be visible. All these features are associated with narrow line Seyfert 1's. A possible spectral discriminant between quasars and Seyfert 1 galaxies was seen. Dissert. Abstr.

# 90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

**N89-15050** Harvard Univ., Cambridge, MA.
**LINEAR CLUSTERS OF GALAXIES Ph.D. Thesis**
Giles Nicholas Fenge Chapman 1987 208 p
Avail: Univ. Microfilms Order No. DA8806068

Linear clusters may impose constraints on cluster evolution and formation models. New data and analytical methods are presented. Three clusters (A194, A999, and A1016) which were classified as linear by Rood and Sastry (1971) were studied. Using galaxy positions and redshifts, cluster membership was assigned. A measure of linearity was devised and a value was obtained for each cluster and for 120 spherically symmetric models. The standard virial mass estimator assumes isotropy and is not appropriate for flattened clusters. The statistical method used to search for galaxy alignments were reassessed and a nonparametric test was proposed. No evidence was found for alignment in the convincingly linear systems (A194 and A1060). All three clusters were tested for luminosity segregation and for variations in the velocity or surface distributions of galaxies as a function of morphological type. Neither the heirarchical clustering model nor the pancake model straightforwardly produce systems with the physical properties of A194. It was suggested that the cluster may be a portion of a shell-like structure similar to those seen in the Center for Astrophysics redshift survey. Dissert. Abstr.

**N89-15051** New Mexico State Univ., University Park.
**A STUDY OF ENVIRONMENTAL INFLUENCES ON THE STRUCTURE OF SPIRAL GALAXY DISKS Ph.D. Thesis**
Wayne Edward Baggett 1987 190 p
Avail: Univ. Microfilms Order No. DA8810755

Detailed photographic surface photometry has been performed on late-type spiral galaxies in the clusters Abell 426, Abell 1367, and Abell 2151. Surface brightness profiles obtained from the photometry are analyzed in terms of environmental parameters such as the projected distance to the nearest neighbor, and local projected galaxy density. Evidence for the modification of the structure of spiral galaxy disks is presented, with some qualitative discussion of the specific causes of the changes. Specifically, the galaxy parameters appear to be influenced by the distance to the nearest neighbor and the local projected galaxy density. Also, there appears to exist a systematic difference in surface brightness at a specific galactocentric distance between the spirals in Abell 1367 and Abell 2151. The elliptical and SO galaxies in these two clusters also exhibit a surface brightness difference, but the trend is in the opposite sense than the trend in the spirals.
Dissert. Abstr.

**N89-15052** Saint Andrew's Univ. (Scotland).
**NONLINEAR MAGNETIC RECONNECTION Ph.D. Thesis**
A. M. Colin 1987 253 p
Avail: Univ. Microfilms Order No. BRD-80646

Magnetic reconnection plays a major role in many astrophysical problems. Despite this reconnection, theory remains incompletely understood, partly due to the strong nonlinearity of the governing equations and the resulting difficulties in demonstrating analytical solutions. An aspect of reconnection theory is examined: the dynamics of driven and spontaneously reconnecting systems. A driven reconnecting system is considered by numerically modeling a configuration consisting of two oppositely oriented flux systems with a variety of different boundary conditions and internal parameters. The results indicate that the rate of reconnection is chiefly dependent on the magnetic Reynolds number. Using the same computer code, tearing modes in Cartesian geometry under different boundary conditions is also simulated. By imposing a suitable perturbation, a magnetic island is generated. The plasma flows show marked differences for the different boundary conditions. Some aspects of the coalescence instability is examined. The usual flux function taken to represent a tearing mode island in the linear growth phase is shown to be erroneous, and a correct expression is derived. Dissert. Abstr.

**N89-15053** Hawaii Univ., Honolulu.
**THE NATURE OF LUMINOUS IRAS GALAXIES Ph.D. Thesis**
Darren Lee DePoy 1987 186 p
Avail: Univ. Microfilms Order No. DA8812137

A flux limited sample of 23 optically identified galaxies was selected from IRAS data that have far infrared luminosities substantially larger than those of normal spiral galaxies. If star formation is the cause of the large luminosities, then strong hydrogen recombination line emission should be present, although substantial extinction is probable. Accordingly, the sample was observed for hydrogen recombination line emission. Sixteen of the sample galaxies were detected in one or both of the lines. Additional infrared photometry and silicate optical depth measurements were used along with measured line ratios to correct the observed line strengths for the effects of extinction and spatially extended emission. Most of the galaxies have line strengths that can be adequately explained by recombination of hydrogen ionized by the continuum radiation from high mass stars. In particular, the ratio of the galaxies' luminosity to the estimated number of ionizing continuum photons is what would be expected from a burst of star formation. The lines are also spectrally unresolved, as expected for a collection of low internal dispersion HII regions taking part in only galactic rotation. Dissert. Abstr.

**N89-15054** Durham Univ. (England).
**CCD POLARIMETRY AS A PROBE OF REGIONS OF RECENT STAR-FORMATION Ph.D. Thesis**
Peter Walter Draper 1988 245 p
Avail: Univ. Microfilms Order No. BRD-81721

The incorporation of a Charged Coupled Device (CCD) detector system with the Durham Imaging Polarimeter is detailed. The details include the physical characteristics of the device and the electronics and software associated with the device control and data storage. The introduction of the CCD detector system has made necessary the inclusion of a super-achromatic half-wave plate in the polarimeter which has an inherent variability in its optic axis. How corrections for this effect can be made is described and first order results are derived. The CCD performance is examined in comparison with the detector used previously and hence the veracity of the new results is established. A summary is presented of the status of the astronomy of the immediate regions of recent star formation. Multicolor polarimetry of NGC2261/R Mon is described covering the period 1979 to 1986. The data proves that the polarization of R Mon must be due to effects close to R Mon. This is evident because of the dynamic timescale of the variations of the polarization of R Mon and the anomalous band of polarizations seen across the head of the nebula.
Dissert. Abstr.

**N89-15055** Minnesota Univ., Minneapolis.
**STUDIES OF THE INTERSTELLAR MEDIUM IN THE INNER GALAXY AT 21 CENTIMETERS Ph.D. Thesis**
Robert Walter Garwood 1987 184 p
Avail: Univ. Microfilms Order No. DA8808468

The results from a Very Large Array snapshot survey of the galactic plane are presented. The positions and peak and total flux densities of 471 sources were measured. The survey is sensitive to sources smaller than about 40 secs. The resolution is 4 secs. An excess number of sources above that expected from extragalactic source counts is seen for l = less than 40 deg. at all flux density intervals. This excess is primarily due to galactic sources associated with radio recombination line sources. There must only be a small number of galactic objects present in the survey which remain unidentified as such. Twenty one of the brightest compact sources found in the continuum survey are used as background sources for a 21 cm HI absorption survey. The results of a search for infrared counterparts to the compact sources found in the VLA survey are presented. Nine red sources likely to be associated with a radio source were found. Most of these seem to be moderately hot, distant main sequence stars and their associated HII regions. Three sources have radio luminosities considerably brighter than expected for this explanation. Some exotic possibilities are considered. Dissert. Abstr.

**N89-15056** Oxford Univ. (England).
**STELLAR MASSES AND LABORATORY ASTROPHYSICS Ph.D. Thesis**
D. J. Haddock 1987 292 p
Avail: Univ. Microfilms Order No. BRD-81566

The problems of measurement of fundamental stellar parameters are approached and in particular stellar mass in the light of both conventional astronomical observations and of measurements made in the lab. Stellar mass is the single most important parameter describing a star and is a fundamental ingredient in studies of stellar evolution. A simple formula relates the mass to measurements of radius and surface gravity. The measurement of effective temperatures and angular diameters are examined, from which radii can be obtained. A technique called the infrared flux method is described and used to calculate these parameters from original flux observations of 74 stars. Two related problems in lab astrophysics are also examined. First, accurate atomic oscillator strengths are measured for very weak lines of neutral iron using the Oxford spectrographic furnace. Secondly, an aspect of temperature measurement in the furnace is investigated, involving the measurement of high temperature spectral emissivities. Dissert. Abstr.

**N89-15057** Stanford Univ., Calif.
**DISK ACCRETION ONTO WEAKLY MAGNETIZED NEUTRON STARS Ph.D. Thesis**
Wlodzimierz Kluzniak 1988 149 p
Avail: Univ. Microfilms Order No. DA8808377

Investigation of the structure of the inner parts of the accretion disk and of the boundary layer in accreting neutron stars with relatively weak magnetic field forms is examined. Two different regimes of accretion are possible. In compact neutron stars, of radii smaller that the tightest Keplerian orbit allowed by general relativity, a gap between the accretion disk and the stellar surface may be formed, through which X-rays can escape without being degraded in the disk. For stars of larger radius, the classical model of a Keplerian disk extending to the neutron star surface is appropriate. The optically thick, scattering dominated regime is analyzed. Disk models constructed with Prandtl's semi-empirical expression for turbulent viscous stresses are compared with models constructed with a local viscous stress tensor. A simple resolution to the problem of vanishing disk height at the radius of zero torque is found. Other difficulties in constructing a Newtonian, radiation pressure dominated, boundary layer solution are discovered and a way of circumventing them is proposed.
Dissert. Abstr.

**N89-15058** State Univ. of New York, Stony Brook.
**CO AND IRAS FIR EMISSION IN INTERACTING GALAXIES Ph.D. Thesis**
Leslie John Sage 1987 147 p
Avail: Univ. Microfilms Order No. DA8812811

The results of a study of the CO J = 1 yields 0 line in a sample of galaxies chosen from the IRAS Point Source Catalog are reported. A scheme was developed for classifying galaxy-galaxy interactions pursuant to developing a model for the evolution of the molecular content of interacting galaxies. The model is developed by considering the CO, far infrared (FIR), UBVJK and the radio continuum emission. The origin of the FIR emission in IRAS galaxies was also investigated and evidence was found that the high luminosities observed in merging galaxies is not entirely due to an increase in star formation activity. There is some support for the view that the Seyfert mechanism can be triggered by a burst of star formation.
Dissert. Abstr.

**N89-15002*#** Lawrence Livermore National Lab., CA.
**EXPERIMENTAL COSMOCHEMISTRY IN THE SPACE STATION**
Al Duba *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15005*#** California Inst. of Tech., Pasadena. Seismological Lab.
**A PLANETARY ULTRA HYPERVELOCITY IMPACT MECHANICS AND SHOCK WAVE SCIENCE FACILITY Abstract Only**
Thomas J. Ahrens *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p Previously announced as N86-27141 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15007*#** Baylor Univ., Waco, TX. Space Science Lab.
**INVESTIGATION OF THE ENHANCED SPATIAL DENSITY OF SUBMICRON LUNAR EJECTA BETWEEN L VALUES 1.2 AND 3.0 IN THE EARTH'S MAGNETOSPHERE: THEORY**
W. M. Alexander, W. G. Tanner, and H. S. Goad *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 9 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15010*#** Chicago Univ., IL. Dept. of Physics.
**COSMIC DUST COLLECTION WITH A SUB SATELLITE TETHERED TO A SPACE STATION**
George J. Corso *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p Previously announced as N86-27146 Prepared in cooperation with Northwestern Univ., Evanston, IL (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15011*#** Lawrence Livermore National Lab., CA.
**ELECTRICAL CONDUCTIVITY OF CARBONACEOUS CHONDRITES AND ELECTRIC HEATING OF METEORITE PARENT BODIES**
Al Duba *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
(Contract W-7405-eng-48)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15012*#** Lawrence Livermore National Lab., CA.
**ELECTRICAL CONDUCTIVITY OF CHONDRITIC METEORITES Abstract Only**
Al Duba, E. M. Didwall, G. J. Burke, and C. P. Sonett (Arizona Univ., Tucson.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
(Contract W-7405-eng-48)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15013*#** Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
**THE ORBIT PROPERTIES OF COLLIDING CO-ORBITING BODIES**
John W. Freeman *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15024*#** Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
**A MAGNETOSPHERIC SIMULATION AT THE SPACE STATION Abstract Only**
R. E. Lopez, John W. Freeman, and F. C. Michel *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 1 p Previously announced as N86-27155 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15025*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX. Dept. of Geology.
**KINETICS IN A TURBULENT NEBULAR CLOUD**
Ian D. R. MacKinnon (New Mexico Univ., Albuquerque.) and F. J. M. Rietmeijer *In its* Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15033*#** Brown Univ., Providence, RI. Dept. of Geological Sciences.
**DEBRIS-CLOUD COLLISIONS: ACCRETION STUDIES IN THE SPACE STATION**
Peter H. Schultz and D. E. Gault (Murphys Center of Planetology, CA.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15034*#** Brown Univ., Providence, RI. Dept. of Geological Sciences.
**IMPACTS OF FREE-FLOATING OBJECTS: UNIQUE SPACE STATION EXPERIMENTS**
Peter H. Schultz and D. E. Gault (Murphys Center of Planetology,

CA.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15035*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.
**HOW TO MAKE A COMET**
James Stephens, R. Stephen Saunders, and Fraser Fanale (Hawaii Univ., Honolulu.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 3 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15036*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
**VOLATILIZATION-FRACTIONATION OF SILICATES RELATED TO CHONDRITE COMPOSITION**
L. S. Walter *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15041*#** San Jose State Univ., Calif.
**NEW TECHNIQUES FOR THE DETECTION AND CAPTURE OF MICROMETEOROIDS Abstract Only**
J. H. Wolfe *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 1 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15042*#** Arizona Univ., Tucson.
**EXPERIMENTAL CONSTRAINTS ON HEATING AND COOLING RATES OF REFRACTORY INCLUSIONS IN THE EARLY SOLAR SYSTEM Abstract Only**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 1 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15043*#** Arizona Univ., Tucson. Dept. of Planetary Sciences, Lunar and Planetary Lab.
**EXPERIMENTAL CONSTRAINTS ON THE ORIGIN OF CHONDRULES Abstract Only**
W. V. Boynton, Drake, Hildebrand, Jones, Lewis, Treiman, and Wark *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

## 91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

**N89-15059*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**SCIENTIFIC RESULTS OF THE NASA-SPONSORED STUDY PROJECT ON MARS: EVOLUTION OF ITS CLIMATE AND ATMOSPHERE**
Stephen M. Clifford, Ronald Greeley (Arizona State Univ., Tempe.), and Robert M. Haberle 9 Nov. 1988 36 p
(Contract NASw-4066)
(NASA-TM-101207; NAS 1.15:101207; LPI-TRN-88-09) Avail: NTIS HC A03/MF A01 CSCL 03B

The scientific highlights of the Mars: Evolution of its Climate and Atmosphere (MECA) study project are reviewed and some of the important issues in Martian climate research that remain unresolved are discussed. Author

**N89-14843*#** Wisconsin Univ., Madison. Fusion Technology Inst.
**THE MOON: AN ABUNDANT SOURCE OF CLEAN AND SAFE FUSION FUEL FOR THE 21ST CENTURY**
G. L. Kulcinski and Harrison H. Schmitt (Schmitt, Harrison H., Albuquerque, NM ) *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 35-64 Presented at the 11th International Scientific Forum on Fueling the 21st Century, Moscow (USSR), 29 Sep. - 6 Oct. 1987 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

**N89-14847*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**LUNAR HYDROGEN: A RESOURCE FOR FUTURE USE AT LUNAR BASES AND SPACE ACTIVITIES**
Everett K. Gibson, Jr., Roberta Bustin (Arkansas Coll., Batesville.), and David S. McKay *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 115-127 Presented at the Symposium on Lunar Bases and Space Activities in the 21st Century, Houston, TX, 5-7 Apr. 1988 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

**N89-14848*#** Wisconsin Univ., Madison. Fusion Technology Inst.
**PROCESSES AND ENERGY COSTS FOR MINING LUNAR HELIUM-3**
I. N. Sviatoslavsky *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 129-146 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

**N89-14849*#** Schmitt (Harrison H.), Albuquerque, NM.
**ECONOMIC GEOLOGY OF LUNAR HELIUM-3**
Harrison H. Schmitt *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 147-157 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

**N89-14850*#** Wisconsin Univ., Madison. Fusion Technology Inst.
**MINING FOR HELIUM: SITE SELECTION AND EVALUATION**
Eugene N. Cameron *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 159-168 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

**N89-14852*#** Astronautics Technology Center, Madison, WI.
**SYNERGISM OF He-3 ACQUISITION WITH LUNAR BASE EVOLUTION**
Thomas M. Crabb and Mark K. Jacobs *In* NASA, Lewis Research Center, Lunar Helium-3 and Fusion Power Sep. 1988 p 193-210 Presented at the Symposium on Lunar Bases and Space Activities in the 21st Century, Houston, Tex., 5-7 Apr. 1988 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

**N89-14853*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
**ASSESSMENT OF LUNAR SOURCES OF He-3 FOR USE ON EARTH**
Robert E. English *In its* Lunar Helium-3 and Fusion Power Sep. 1988 p 227-231 (For primary document see N89-14842 06-75)
Avail: NTIS HC A11/MF A01 CSCL 03B

**N89-14999*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
**PLANETARY IMPACT EXPERIMENTATION**
Mark J. Cintala, Peter H. Schultz (Brown Univ., Providence, RI.), and Friedrich Hoerz *In its* Experiments in Planetary and Related Sciences and the Space Station , Nov. 1987 16 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15000*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**PHYSICS OF WINDBLOWN PARTICLES**
Ronald Greeley, Rodman Leach, John R. Marshall, Bruce White, James D. Iversen, William G. Nickling, Dale Gillette, and Michael Sorensen (Aarhus Univ., Denmark ) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 29 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

**N89-15001*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
**PARTICLE FORMATION AND INTERACTION**
Steven Squyres, George J. Corso, Lynn D. Griffiths, Ian D. R. MacKinnon, John R. Marshall, Joseph A. Nuth, III, Brad Werner, and John Wolfe (San Jose State Univ., Calif.) *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 4 p Previously announced as N86-27139 (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

# 92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

**N89-15060** Stanford Univ., Calif.
**AN INVESTIGATION OF GROUND-BASED OBSERVATIONS OF SOLAR OSCILLATIONS AT STANFORD Ph.D. Thesis**
Harald Martin Jakob Henning 1988 224 p
Avail: Univ. Microfilms Order No. DA8808370

Global oscillations of the sun were observed at the Wilcox Solar Observatory at Stanford using measurements of the Doppler shift of a nonmagnetic photospheric line. The discovery and identification of previously undetected p-modes as well as the detection of peaks corresponding to g-mode oscillations are presented. The effects of sky transparency and data gaps are also discussed as they relate to observations of solar oscillations. The differential observations are sensitive to p-modes of spherical harmonic degree 2 through 5. The detection and identification of p-modes at frequencies from 1000 to 5000 micro-Hz is discussed. The analysis and processing of the data for the purpose of extracting the frequencies of g-mode oscillation modes is discussed. Data gaps introduced by the day/night cycle and bad weather degrade the spectrum and introduce severe problems for the extraction of mode information. Transparency variations in the sky, both static and noisy, also introduce unwanted power into the spectrum, causing problems especially for the detection of g-modes. The effects of these sources of error is systematically examined. Dissert. Abstr.

**N89-15061#** Los Alamos National Lab., NM.
**THE BAKSAN NEUTRINO OBSERVATORY SOVIET-AMERICAN GALLIUM SOLAR NEUTRINO EXPERIMENT**
A. I. Abazov, D. N. Abdurashitov, O. V. Anosov, A. V. Avdeyev, Yu. I. Belouska, O. V. Bychuk, S. N. Danshin, L. A. Eroshkina, E. L. Faizov, and V. N. Gavrin et al. 1988 15 p Presented at the 13th International Conference on Neutrino Physics and Astrophysics, Boston, MA, 5 Jun. 1988 Submitted for publication Prepared in cooperation with Academy of Sciences, Moscow, USSR, Pennsylvania Univ., Philadelphia, Louisiana State Univ., Baton Rouge and Princeton Univ., NJ
(Contract W-7405-eng-36)
(DE89-000375; LA-UR-88-2927; CONF-8806204-4) Avail: NTIS HC A03/MF A01

A radiochemical Ga-71- Ge-71 experiment to determine the integral flux of neutrinos from the sun is currently under preparation at the Baksan Neutrino Observatory in the USSR. Measurements are scheduled to commence by late 1988 with 30 tons of metallic gallium. A fractional statistical accuracy of 18 percent is expected to be obtained after one year of operation if the solar signal is 70 SNU, the flux expected from p-p neutrinos alone. While initial measurements are in progress, 30 additional tons of gallium will be installed in order to perform the full experiment with a 60-ton target. DOE

**N89-15062#** Stanford Univ., Calif. Center for Space Science and Astrophysics.
**MAGNETIC PROPERTIES OF C 4 DOPPLER SHIFT PATTERNS**
James A. Klimchuk Apr. 1988 31 p
(Contract N00014-85-K-0111)
(AD-A198602; CSSA-ASTRO-88-12) Avail: NTIS HC A03/MF A01 CSCL 03B

The relationship between Doppler shift patterns observed in the transition region and magnetic field patterns observed in the photosphere is studied using coaligned pairs C IV Dopplergrams and Fe I magnetograms. Categories of magnetic features are defined--including neutral lines, unipolar regions, strong field regions, weak field regions, and magnetic boundaries--and from these, magnetic associations are determined for 159 V0 lines separating areas of relative blueshift and redshift observed in and nearby to active regions. The cases are subdivided on the basis of whether blueshifts or redshifts are observed on the side of the V0 line nearest the limb. Two of the main results are that V0 lines associated with neutral lines tend to have limbward blueshifts, while V0 lines associated with unipolar regions tend to have limbward redshifts. These and other results provide supportive evidence for the active region model proposed recently by Klimchuk, in which relative redshifts occur where strong vertical fields penetrate the surface, and relative blueshifts occur where these same fields have spread out to become horizontal. It is likely that the relative blueshifts correspond to absolute Doppler shifts of very small amplitude, possibly even redshifts. GRA

**N89-15063*#** Maryland Univ., College Park. Inst. for Physical Science and Technology.
**ANALYSIS OF ISEE-3/ICE SOLAR WIND DATA Final Report**
Michael A. Coplan 9 Jan. 1989 6 p
(Grant NAG5-579)
(NASA-CR-184652; NAS 1.26:184652) Avail: NTIS HC A02/MF A01 CSCL 03B

Under the grant that ended November 11, 1988 work was accomplished in a number of areas, as follows: (1) Analysis of solar wind data; (2) Analysis of Giacobini/Zinner encounter data; (3) Investigation of solar wind and magnetospheric electron velocity distributions; and (4) Experimental investigation of the electronic structure of clusters. Reprints and preprints of publications resulting from this work are included in the appendices. Author

**N89-15019*#** Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
**KINETICS OF MINERAL CONDENSATION IN THE SOLAR NEBULA Abstract Only**
T. L. Grove *In* NASA, Lyndon B. Johnson Space Center, Experiments in Planetary and Related Sciences and the Space Station Nov. 1987 2 p (For primary document see N89-14998 06-88)
Avail: NTIS HC A09/MF A01 CSCL 03B

# 93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

**N89-15064** Case Western Reserve Univ., Cleveland, OH.
**PREDICTED PERFORMANCE OF A PROTOTYPE SOLAR NEUTRON DETECTOR Ph.D. Thesis**
Geoffrey Nelson Pendleton 1988 229 p
Avail: Univ. Microfilms Order No. DA8811163

The operating characteristics of a solar neutron detector designed to observe neutrons produced in solar flares are presented. The detector's performance is predicted using Monte Carlo computer simulations. The detector system has a very high efficiency in comparison to other types of neutron detectors and it is capable of measuring the neutron's energy accurately. The detector consists of a neutron track chamber detector made of plastic scintillation fibers. Charged particles traveling through the detector chamber produce tracks since some of the light they produce is channeled down the fibers by total internal reflection. The chamber is followed by a time of flight detector to measure the velocity of charged particles emerging from the back of the detector. The plastic scintillator simulated consists of carbon and hydrogen. The unique feature of this simulation is that the reaction particles produced by neutron-carbon inelastic interactions are completely simulated so that their detailed effect on the detector's performance is ascertained. Results are presented in the incident neutron energy range from 15 to 900 MeV. The performance of the detector in the near earth environment is discussed.
Dissert. Abstr.

**N89-15065** Washington Univ., Seattle.
**PAIR PRODUCTION AND ANNIHILATION IN GAMMA-RAY BURSTS Ph.D. Thesis**
Brian John Carrigan 1987 133 p
Avail: Univ. Microfilms Order No. DA8812751

The results of nonlinear radiative transport calculations of relevance to gamma-ray bursts and emission from the center of the galaxy are reported. Two-photon pair production and annihilation, as well as three-photon pair annihilation, are included in the calculations; the radiation field itself acts as an absorbing medium, and the optical depth depends on the radiation field. Spherical geometry produces effective collimation of the flux. At high optical depth the high-energy (greater than 700 keV) portion of the emergent spectrum assumes a nearly-universal form. An approximate limit is derived for the high-energy flux from a gamma-ray burst source, and the implications of this limit for the 5 March, 1979 event are briefly discussed. Dissert. Abstr.

**N89-15066** State Univ. of New York, Stony Brook.
**THE CIRCUMSTELLAR ENVELOPES OF YOUNG STELLAR OBJECTS AND EMISSION LINE STARS Ph.D. Thesis**
Frederick William Hamann, III 1987 157 p
Avail: Univ. Microfilms Order No. DA8812699

High resolution measurements of infrared emission lines in several T-Tauri stars, the luminous emission line star MWC 349A, and the Be star Gamma Cas are presented. These observations are used to study the physical conditions in the line forming regions, and the implications are discussed for models of the circumstellar envelopes. The first detection of a CO bandhead emission in DG Tau is reported. The MWC 349A spectra identify both ionized and neutral gas emission regions. The line profiles indicate a complex enevelope velocity field, which is interpreted as resulting from a rotating disk and bipolar outflor. The measured emission lines from Gamma Cas are consistent with disk models of Be star envelopes. Dissert. Abstr.

**N89-15067#** Lawrence Livermore National Lab., CA. Physics Dept.
**GAMMA RAYS FROM CYGNUS X-1: NEW DIAGNOSTICS FOR A BLACK HOLE**
Edison P. Liang Aug. 1988 14 p Presented at the NATO Advanced Study Institute Conference on Cosmic Gamma Rays and Cosmic Neutrinos, Erice, Italy, 20-30 Apr. 1988
(Contract W-7405-eng-48)
(DE88-016275; UCRL-99411; CONF-8804192-1) Avail: NTIS HC A03/MF A01

New gamma ray observations of Cygnus X-1, especially those with the HEAO-3 satellite, have revealed a transient bump in the 0.4 - few MeV region. Its successful interpretation in terms of the optically thin emission from a compact cloud of semi-relativistic plasma close to the black horizon has shed new light on the structure and dynamics of the accretion flow. Detailed spectral and temporal analyses of the HEAO and other gamma ray data may thus provide an important new diagnostic of black holes not obtainable with X-ray observations. This has important implications for both the theory and strategies of future high energy observation of black holes. DOE

**N89-15068#** Lawrence Livermore National Lab., CA. Lab. for Experimental Astrophysics.
**A HARD X-RAY SPECTROMETER FOR HIGH ANGULAR RESOLUTION OBSERVATIONS OF COSMIC SOURCES**
C. J. Hailey, K. P. Ziock, F. Harrison, S. M. Kahn, D. Liedahl, P. M. Lubin, and M. Seiffert (California Univ., Santa Barbara.) 12 Aug. 1988 7 p Presented at the 32d International Technical Symposium on Optical and Opto-electronic Applied Sciences and Engineering, San Diego, CA, 14-19 Aug. 1988
(Contract W-7405-eng-48)
(DE88-017005; UCRL-98175; CONF-880887-14) Avail: NTIS HC A02/MF A01

LAXRIS (large area X-ray imaging spectrometer) is an experimental, balloon-borne, hard X-ray telescope that consists of a coaligned array of X-ray imaging spectrometer modules capable of obtaining high angular resolution (1 to 3 arcminutes) with moderate energy resolution in the 20- to 300-keV region. Each spectrometer module consists of a CsI(Na) crystal coupled to a position-sensitive phototube with a crossed-wire, resistive readout. Imaging is provided by a coded aperture mask with a 4-m focal length. The high angular resolution is coupled with rather large area (approximately 800 sq cm) to provide good sensitivity. Results are presented on performance and overall design. Sensitivity estimates are derived from a Monte Carlo code developed to model the LAXRIS response to background encountered at balloon altitudes. We discuss a variety of observations made feasible by high angular resolution. For instance, spatially resolving the nonthermal X-ray emission from clusters of galaxies is suggested as an ideal program for LAXRIS. DOE

**N89-15069#** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
**MODELLING OF CENTRAL DENSITY SPECTRA OF EXTENSIVE AIR SHOWERS FROM PRIMARY PARTICLES WITH E=10(SUP 2)-10(SUP 7) GeV**
G. Kh. Arkhestov and Kh. M. Beshtoev 1987 8 p In RUSSIAN; ENGLISH summary
(DE88-703728; JINR-R-2-87-504) Avail: NTIS (US Sales Only) HC A02/MF A01

Calculations are made for the distributions of central densities of extensive air showers (of electromagnetic particles) by integrating over radii R approx =0.4 m and R aaprox =0.8 m and the spectrum over the total number of particles in a shower of primary incident particles with E=10 to the 2d and 10 to the 7th GeV. Comparison with experiment is presented. DOE

**N89-15070*#** National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
**PRELIMINARY ESTIMATES OF GALACTIC COSMIC RAY SHIELDING REQUIREMENTS FOR MANNED INTERPLANETARY MISSIONS**
Lawrence W. Townsend, John W. Wilson, and John E. Nealy Oct. 1988 22 p
(NASA-TM-101516; NAS 1.15:101516) Avail: NTIS HC A03/MF A01 CSCL 03B

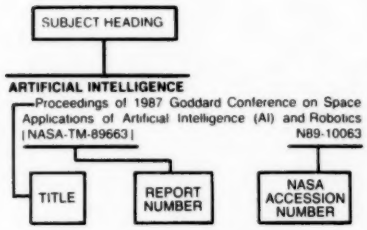
Estimates of radiation risk to the blood forming organs from galactic cosmic rays are presented for manned interplanetary missions. The calculations use the Naval Research Laboratory cosmic ray spectrum model as input into the Langley Research Center galactic cosmic ray transport code. This transport code, which transports both heavy ions and nucleons, can be used with any number of layers of target material, consisting of up to five different constituents per layer. Calculated galactic cosmic ray doses and dose equivalents behind various thicknesses of aluminum and water shielding are presented for solar maximum and solar minimum periods. Estimates of risk to the blood forming organs are made using 5 cm depth dose/dose equivalent values for water. These results indicate that at least 5 g/sq cm (5 cm) of water of 6.5 g/sq cm (2.4 cm) of aluminum shield is required to reduce annual exposure below the current recommended limit of 50 rem. Because of the large uncertainties in fragmentation parameters, and the input cosmic ray spectrum, these exposure estimates may be uncertain by as much as 70 percent. Therefore, more detailed analyses with improved inputs could indicate the need for additional shielding. Author

**N89-14907*#** Arizona Univ., Tucson. Dept. of Nuclear and Energy Engineering.
**BENCHMARK SOLUTIONS FOR THE GALACTIC ION TRANSPORT EQUATIONS WITH SPATIAL AND ENERGY COUPLING Abstract Only**
Barry D. Ganapol *In* Hampton Inst., NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988 p 59-60 (For primary document see N89-14896 06-80)
Avail: NTIS HC A07/MF A01 CSCL 03B

## 99 GENERAL

No abstracts in this category.

## Typical Subject Index Listing

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## A


**ABSORBERS (MATERIALS)**
Evaluation of microwave anechoic chamber absorbing materials
[AD-A198055] N89-14320

**ABSORPTION SPECTRA**
Ground-based measurements of O3, NO2, OClO, and BrO during the 1987 Antarctic ozone depletion event N89-14543
An FTIR spectrometer for remote measurements of atmospheric composition N89-14550

**ABSTRACTS**
USL NASA/RECON project presentations at the 1985 ACM Computer Science Conference: Abstracts and visuals
[NASA-CR-184522] N89-14962

**ABUNDANCE**
Infrared aircraft measurements of stratospheric composition over Antarctica during September 1987 N89-14546
Visible and near-ultraviolet spectroscopy at Thule AFB (76.5 N) from January 28 - February 15, 1988 N89-14576

**ACCOMMODATION COEFFICIENT**
Mass accommodation coefficient measurements for HNO3, HCl and N2O5 on water, ice and aqueous sulfuric acid droplet surfaces N89-14538

**ACCRETION DISKS**
A study of environmental influences on the structure of spiral galaxy disks N89-15051
Disk accretion onto weakly magnetized neutron stars N89-15057

**ACCUMULATIONS**
Analytical and experimental characterization of damage processes in composite laminates
[AD-A198068] N89-14262

**ACCURACY**
Geolocation via satellite: A methodology and error analysis
[AD-A197955] N89-14253
Cryogenic thermometers based on TVO type resistors and their application
[DE88-703755] N89-14413

**ACETYLENE**
Polysilylated unsaturated molecules
[AD-A198492] N89-14328

**ACOUSTIC EXCITATION**
Response of composite plates subjected to acoustic loading
[NASA-CR-184618] N89-14469

**ACOUSTIC FATIGUE**
Response of composite plates subjected to acoustic loading
[NASA-CR-184618] N89-14469

**ACOUSTIC LEVITATION**
Controlled sample orientation and rotation in an acoustic levitator
[NASA-CASE-NPO-17086-1-CU] N89-14422

**ACOUSTIC MEASUREMENT**
Ultrasonic depth gauge for liquids under high pressure
[NASA-CASE-LAR-13300-1-CU] N89-14407

**ACOUSTIC SCATTERING**
Acoustic phonon scattering in modulation doped Aluminum (subx) Gallium (sub 1x) Arsenide/Gallium arsenide heterojunctions
[AD-A198512] N89-14885

**ACOUSTIC SOUNDING**
Automatic detection of inversions using sodar
[KNMI-TR-106] N89-14631

**ACOUSTICS**
Phase transformation and enhanced nuclear resonance in acoustics N89-14816

**ACOUSTO-OPTICS**
Development of a contactless optoacoustic method for nondestructive testing. Part 2: Optical excitation of ultrasonic vibrations
[TPD-1987-0-2-PT-2] N89-14454
Integrated acoustooptic device modules for optical information processing
[AD-A198061] N89-14835

**ACQUISITION**
DEH (Directorates of Engineering and Housing) automated graphics guide: Selection, acquisition, implementation, and management
[AD-A198489] N89-14721

**ACRYLIC ACID**
Anelastic and thermal properties of ethylene/acrylic acid copolymers partially ionized with transition metals
[DE88-017006] N89-14316

**ACTIVE GALACTIC NUCLEI**
Evolution of photon and particle spectra in compact, luminous objects
[NASA-TM-101247] N89-14825
Optical spectroscopy of X-ray: Selected active galactic nuclei N89-15049
The nature of luminous IRAS galaxies N89-15053

**ACTUATORS**
Design of feedback control systems for unstable plants with saturating actuators
[NASA-CR-183392] N89-14377
Light weight high performance manipulators
[AD-A198647] N89-14448

**ADDITIVES**
Long-lived resonance states in Si-doped AlGaAs
[DE89-000305] N89-14879

**ADHESION**
Durability of adhesive joints: An engineering study
[PB88-233473] N89-14307

**ADHESIVE BONDING**
Characterization study of the structural bonding system EA 9680 (EA 9645). Test report 1/R/86
[REPT-1/R/86] N89-14334
Metal-metal bonding: Contribution to the study of aging. Test report 48-453/F
[REPT-48-453/F] N89-14335

**ADRENOCORTICOTROPIN (ACTH)**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
[AD-A197472] N89-14668

**ADSORPTION**
Adsorption of chlorine on clean and on oxygen pre-exposed Al(3)
[AD-A198005] N89-14280
The effect of parasitic absorption losses on light trapping in thin silicon solar cells
[DE89-000457] N89-14501

**ADVANCED VERY HIGH RESOLUTION RADIOMETER**
Possible measurement errors in calibrated AVHRR (Advanced Very High Resolution Radiometer) data
[AD-A198342] N89-14414
Classification and analysis of surface and clouds at high latitudes from AVHRR multispectral satellite data N89-14635

**ADVECTION**
A study of a rapid cyclogenesis event during gale
[AD-A198555] N89-14645
The role of horizontal processes in upper-ocean prediction: A forecast simulation in the Sea of Japan
[AD-A198827] N89-14654
Universal limiter for transient interpolation modeling of the advective transport equations: The ULTIMATE conservative difference scheme
[NASA-TM-100916] N89-14794

**AEOLIAN TONES**
Physics of windblown particles N89-15000
Sediment-transport experiments in zero-gravity N89-15020
Design and calibration of the carousel wind tunnel N89-15021
Development and testing of a unique carousel wind tunnel to experimentally determine the effect of gravity and the interparticle force on the physics of wind-blown particles
[WHITE, BRUCE R.] N89-15022
Aeolian processes aboard a Space Station: Saltation and particle trajectory analysis N89-15039

**AEROASSIST**
Aeroassisted orbital transfer vehicle control technology
[NASA-CR-179424] N89-14250

**AERODYNAMIC CHARACTERISTICS**
Two-dimensional aerodynamic characteristics of the OLS/TAAT airfoil
[NASA-TM-89435] N89-14216

**AERODYNAMIC CONFIGURATIONS**
Numerical grid generation and potential airfoil analysis and design
[AD-A197972] N89-14219

**AERODYNAMIC LOADS**
Efficient load measurements using singular value decomposition
[NASA-CR-184614] N89-14795
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight
[NASA-CR-4212] N89-14821

**AERODYNAMIC STALLING**
Dynamic stall computations using a zonal Navier-Stokes model
[AD-A197942] N89-14397

**AERODYNAMICS**
A walk along interfaces --- aeroelasticity
[B8817008] N89-14223
Approaches to non-linear aerodynamic analysis and design N89-14909

**AEROELASTICITY**
Transonic aeroelastic analysis of launch vehicle configurations
[NASA-CR-4186] N89-14215
A walk along interfaces --- aeroelasticity
[B8817008] N89-14223

**AEROSOLS**
Antarctic measurements of ozone, water vapor, and aerosol extinction by Sage 2 in the spring of 1987 N89-14508

The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
Comparison of in situ aerosol measurements with SAGE 2 and SAM 2 aerosol measurements during the airborne Antarctic ozone experiment N89-14522
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
Filter measurements of chemical composition during the airborne Antarctic ozone experiment N89-14526
Antarctic polar stratospheric aerosols: The roles of nitrates, chlorides and sulfates N89-14527
On the size and composition of particles in polar stratospheric clouds N89-14528
In-situ measurements of total reactive nitrogen, total water vapor, and aerosols in polar stratospheric clouds in the Antarctic stratosphere N89-14531
Photochemical modeling of the Antarctic stratosphere: Observational constraints from the airborne Antarctic ozone experiment and implications for ozone behavior N89-14569
Radiative aspects of Antarctic ozone hole in 1985 N89-14592
Aerosol characteristics in the Marine Boundary Layer over the Straits of Gibraltar, June 1986 | AD-A197945 | N89-14642
Field tests and experiments on visibility modification | AD-A197956 | N89-14643

**AEROSPACE ENVIRONMENTS**
TIROS/NOAA (television and infrared observation satellite/National Oceanic and Atmospheric Administration) satellites space environment monitor archive tape documentation, 1988 update | PB88-224613 | N89-14619

**AEROSPACE MEDICINE**
JPRS report: Science and technology. USSR: Life sciences | JPRS-ULS-87-008 | N89-14658
Cardiovascular system and space environment | ETN-89-93600 | N89-14674
Aerospace medicine and biology: A continuing bibliography with indexes | NASA-SP-7011(318) | N89-14675

**AEROSPACE PLANES**
The viscoplastic behavior of SCS6/Ti-15-3 metal matrix composite materials at elevated temperatures N89-14929

**AGGREGATES**
Cautionary tales for reduced-gravity particle research N89-15026
Debris-cloud collisions: Accretion studies in the Space Station N89-15033

**AGING (MATERIALS)**
Data acquisition and control for multiple composite life tests | AD-A198395 | N89-14263
Metal-metal bonding: Contribution to the study of aging. Test report 48-453/F | REPT-48-453/F | N89-14335

**AH-1G HELICOPTER**
Two-dimensional aerodynamic characteristics of the OLS/TAAT airfoil | NASA-TM-89435 | N89-14216

**AIR**
The precise determination of the refractive index of air | NPL-MOM-90 | N89-14629
Modeling of hydrogen-air diffusion flame N89-14913

**AIR DROP OPERATIONS**
The effect of pyridostigmine bromine on inflight aircrew performance | AD-A198828 | N89-14670

**AIR FLOW**
Passive venting technique for shallow cavities | NASA-CASE-LAR-14031-1 | N89-14232
Underexpanded noncondensing turbulent gas jets in liquids | AD-A197939 | N89-14396

**AIR MASSES**
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585

**AIR POLLUTION**
Analysis of crop loss for alternative ozone exposure indices | PB88-214788 | N89-14608
Assessing the risks of trace gases that can modify the stratosphere. Volume 1: Executive summary | PB88-231055 | N89-14610
Assessing the risks of trace gases that can modify the stratosphere. Volume 6: Technical support documentation production projections | PB88-231071 | N89-14611
Assessing the risks of trace gases that can modify the stratosphere. Volume 7: Technical support documentation atmospheric science papers | PB88-231089 | N89-14612
Assessing the risks of trace gases that can modify the stratosphere. Volume 8: Technical support documentation ozone depletion and plants | PB88-231097 | N89-14613
A microcomputer pollution model for civilian airports and air force bases, model description | AD-A199003 | N89-14616
Modeling of hydrogen-air diffusion flame N89-14913

**AIR SAMPLING**
Filter measurements of chemical composition during the airborne Antarctic ozone experiment N89-14526
Trace gas measurements from whole air samples collected over the Antarctic continent N89-14561
Rocket- and aircraft-borne trace gas measurements in the winter polar stratosphere N89-14574

**AIR TRAFFIC CONTROL**
Evaluation of the pseudo pilot effect on baseline controller study data N89-14920
A flight test design for studying airborne applications of air to ground duplex data link communications N89-14924

**AIR TRAFFIC CONTROLLERS (PERSONNEL)**
Workload for air combat and air traffic controllers | IZF-1987-32 | N89-14230

**AIR WATER INTERACTIONS**
Aerosol characteristics in the Marine Boundary Layer over the Straits of Gibraltar, June 1986 | AD-A197945 | N89-14642

**AIRBORNE EQUIPMENT**
Southern Hemispheric nitrous oxide measurements obtained during 1987 airborne Antarctic ozone experiment N89-14557
Observational results of microwave temperature profile measurements from the airborne Antarctic ozone experiment N89-14558
Temperature and horizontal wind measurements on the ER-2 aircraft during the 1987 airborne Antarctic ozone experiment N89-14560
The meteorological measurement system on the NASA ER-2 aircraft N89-14562
Photochemical modeling of the Antarctic stratosphere: Observational constraints from the airborne Antarctic ozone experiment and implications for ozone behavior N89-14569
Rocket- and aircraft-borne trace gas measurements in the winter polar stratosphere N89-14574
In situ observations of ClO in the wintertime Northern Hemisphere: ER-2 aircraft results from 21 N to 61 N latitude N89-14575
Airborne measurements of tropospheric ozone destruction and particulate bromide formation in the Arctic N89-14582

**AIRBORNE/SPACEBORNE COMPUTERS**
Spacelab system analysis: A study of communications systems for advanced launch systems | NASA-CR-183515 | N89-14248

**AIRCRAFT COMMUNICATION**
A flight test design for studying airborne applications of air to ground duplex data link communications N89-14924

**AIRCRAFT CONSTRUCTION MATERIALS**
Materials and structures for hypersonic vehicles | NASA-TM-101501 | N89-14264

**AIRCRAFT CONTROL**
A unified approach to vehicle design, control, and flight path optimization N89-14231
The effect of pyridostigmine bromine on inflight aircrew performance | AD-A198828 | N89-14670
The poststall nonlinear dynamics and control of an F-18: A preliminary investigation N89-14922

**AIRCRAFT DESIGN**
A walk along interfaces --- aeroelasticity | B8817008 | N89-14223
A unified approach to vehicle design, control, and flight path optimization N89-14231
Approaches to non-linear aerodynamic analysis and design N89-14909

**AIRCRAFT DETECTION**
Further investigation of contrast sensitivity and visual acuity in pilot detection of aircraft | AD-A198434 | N89-14680

**AIRCRAFT ENGINES**
Fire extinguishing agent evaluation in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS) | AD-A198523 | N89-14227
Engines for Mini-RPV XM-1A | AD-A198336 | N89-14236

**AIRCRAFT EQUIPMENT**
Fabrication and testing of lightweight hydraulic system simulator hardware. Phase 2: Addendum | AD-A198524 | N89-14243

**AIRCRAFT HAZARDS**
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899

**AIRCRAFT LANDING**
Precision approach radars Twenthe and Volkel (Netherlands). Multipath propagation problems | FEL-1988-15 | N89-14372

**AIRCRAFT MAINTENANCE**
The nature of the aircraft component failure process: A working note | AD-A197979 | N89-14234
Expert systems in higher echelon maintenance activities N89-14761

**AIRCRAFT MANEUVERS**
Calculation of the steadily periodic and gust responses of a hingeless rotor helicopter using two-dimensional time domain unsteady aerodynamics N89-14240
The poststall nonlinear dynamics and control of an F-18: A preliminary investigation N89-14922

**AIRCRAFT NOISE**
Detailed design specification for a prototype Assessment System for Aircraft Noise (ASAN) | AD-A197936 | N89-14818

**AIRCRAFT PILOTS**
Mental models for time displayed tasks | AD-A198536 | N89-14682
Evaluation of the pseudo pilot effect on baseline controller study data N89-14920

**AIRCRAFT SPECIFICATIONS**
Modern computer-aided tools for high-resolution weapons system engineering | AD-A197855 | N89-14710

**AIRCRAFT STABILITY**
A unified approach to vehicle design, control, and flight path optimization N89-14231
Optimization of slender wings for center-of-pressure shift due to change in Mach number N89-14897

**AIRCRAFT STRUCTURES**
Materials and structures for hypersonic vehicles | NASA-TM-101501 | N89-14264
Efficient load measurements using singular value decomposition | NASA-CR-184614 | N89-14795

**AIRFOIL OSCILLATIONS**
Dynamic stall computations using a zonal Navier-Stokes model | AD-A197942 | N89-14397

**AIRFOILS**
Two-dimensional aerodynamic characteristics of the OLS/TAAT airfoil | NASA-TM-89435 | N89-14216
Numerical grid generation and potential airfoil analysis and design | AD-A197972 | N89-14219
High lift, low pitching moment airfoils | NASA-CASE-LAR-13215-1 | N89-14224

**AIRLOCK MODULES**
Transfer airlock requirements | TAL-RP-SN-003 | N89-14254

**AIRPORTS**
A microcomputer pollution model for civilian airports and air force bases, model description | AD-A199003 | N89-14616
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899

**ALBEDO**
Texture-based cloud classification N89-14931

**ALGEBRA**
Computation of algebraic polynomial parametric surface intersections | PB88-208277 | N89-14778
A direct iterative-variational method for solving large sets of linear algebraic equations | DE88-016149 | N89-14780
Analogs of Clifford algebra for forms above quadratic and their matrix realization | DE88-703748 | N89-14787

**ALGORITHMS**
Comparison of the general dynamics ground clobber algorithm with the GCAS and laws algorithms | AD-A198479 | N89-14226
Finite element electromagnetic scattering: An interactive micro-computer algorithm | AD-A198552 | N89-14364
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet | AD-A198360 | N89-14399
A numerical simulation of the flow field and heat transfer in a rectangular passage with a turbulence promoter | AD-A198579 | N89-14400
Shock response spectrum anomalies which occur due to imperfections in the data | DE88-015846 | N89-14459
The JNC-16: A 16-channel data acquisition and analysis module | DE88-017200 | N89-14699
Cloud classification from satellite data using a fuzzy sets algorithm: A polar example | NASA-CR-184568 | N89-14708

Random access algorithms for multiuser computer communication networks
| AD-A198090 | N89-14713
Pattern-directed invocation with changing equalities
| AD-A198146 | N89-14715
Robust algorithms for detecting a change in a stochastic process with infinite memory
| AD-A198290 | N89-14716
Ordering methods for sparse matrices and vector computers
| AD-A198291 | N89-14717
Fault-tolerant distributed algorithms for agreement and election
| AD-A198416 | N89-14718
A 3-D object recognition system using aspect graphs
| AD-A198472 | N89-14720
A survey of the state-of-the-art and focused research in range systems
| NASA-CR-184595 | N89-14726
A software package for sequential quadratic programming
| DFVLR-FB-28-28 | N89-14731
Evaluation of work distribution algorithms and hardware topologies in a multi-transputer network
| AD-A198530 | N89-14736
Numbering of new elements for net refinement
| NASA-TT-20435 | N89-14737
Approximation methods for the consistent initialization of differential-algebraic equations
| DE88-017316 | N89-14781
Numerical schemes in the stabilization method for nonlinear differential equations of second order
| DE88-703773 | N89-14789
Determining conductivity by boundary measurements: Some numerical results
| AD-A198014 | N89-14792

**ALKALOIDS**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
| AD-A197472 | N89-14668

**ALLOYS**
Castable hot corrosion resistant alloy
| NASA-CASE-LEW-14134-2 | N89-14303
A viscoplastic constitutive model for anisotropic metals at high temperature N89-14305
Thermal analysis system (DSC, TGA, TMA) for oxidation and phase transformation studies of alloys with mestable phase
| AD-A198420 | N89-14415
The influence of porosity on short fatigue crack growth at large strain amplitudes
| AD-A198477 | N89-14464

**ALTERNATING CURRENT**
Influence of the A.C. Stark effect on stimulated hyper-Raman profiles in sodium vapor
| DE88-015557 | N89-14429

**ALTITUDE**
The morphology and meteorology of Southern Hemisphere spring total ozone mini-holes N89-14516

**ALUMINUM**
Adsorption of chlorine on clean and on oxygen pre-exposed Al(3)
| AD-A198005 | N89-14280
Tribological characteristics of coatings on aluminium and its alloys N89-14290
Oxidation behavior of FeAl + Hf,Zr,B
| NASA-TM-101402 | N89-14297
Simulation studies for surfaces and materials strength
| NASA-CR-183378 | N89-14824

**ALUMINUM ALLOYS**
Tribological characteristics of coatings on aluminium and its alloys N89-14290
The development of iron-aluminium based alloys for aqueous corrosion resistance N89-14291
Characterization study of the structural bonding system EA 9680 (EA 9645). Test report 1/R/86
| REPT-1/R/86 | N89-14334
Metal-metal bonding: Contribution to the study of aging. Test report 48-453/F
| REPT-48-453/F | N89-14335
Fatigue evolution of small two and three dimensional cracks under variable and constant amplitude loading
| MM-AL/AP-04-88 | N89-14471

**ALUMINUM COMPOUNDS**
Low temperature heat capacities of several high strength materials
| AD-A198300 | N89-14299

**ALUMINUM GALLIUM ARSENIDES**
High-power AlGaAs channeled substrate planar diode lasers for spaceborne communications
| NASA-CR-4189 | N89-14426
Long-lived resonance states in Si-doped AlGaAs
| DE89-000305 | N89-14879
Acoustic phonon scattering in modulation doped Aluminum (subx) Gallium (sub 1x) Arsenide/Gallium arsenide heterojunctions
| AD-A198512 | N89-14885

**ALUMINUM OXIDES**
Creep behavior of an Al2O3-SiC composite
| DE88-014553 | N89-14260
Synchronously pumped mode-locked Ti:Al2O3 lasers N89-14344
Residual infrared absorption in Ti:Al2O3 crystals N89-14345

**AMIDES**
Condensation polymers with controlled structure
| AD-A198086 | N89-14321

**AMINES**
Gas Chromatographic and spectroscopic studies of Cobalt (II) and other selected transition metal chelates of tetradentate beta-ketoenamines N89-14269

**AMINO ACIDS**
Firefly luciferase-structure and function
[AD-A198292] N89-14283

**AMMONIUM NITRATES**
Discussion and explanation of unplanned ignition incident: Ignition caused by rapid pressurization of a propellant containing bubbles
[AD-A198419] N89-14340

**AMPLIFICATION**
Chirped pulse amplification: Present and future
| DE89-001016 | N89-14434
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
| AD-A198361 | N89-14439

**AMPLITUDES**
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
| AD-A198361 | N89-14439

**ANALOG DATA**
Use of laser diodes for analog fiber optic diagnostics systems
| DE88-017012 | N89-14833

**ANALOG TO DIGITAL CONVERTERS**
Frequency domain laser velocimeter signal processor
| NASA-CASE-LAR-13552-1-CU | N89-14385
Adaptable pulsed analog-to-digital converter
| DE88-703778 | N89-14701

**ANALOGS**
Development of the general interpolants method for the CYBER 200 series of supercomputers
| NASA-CR-4183 | N89-14704
Analogs of Clifford algebra for forms above quadratic and their matrix realization
| DE88-703748 | N89-14787

**ANALYSIS (MATHEMATICS)**
Research conducted at the Institute for Computer Applications in Science and Engineering in applied mathematics, numerical analysis and computer science
| NASA-CR-181757 | N89-14694
Mathematical sciences: Some research trends
| PB88-232798 | N89-14779

**ANALYSIS OF VARIANCE**
Nonparametric estimation of optimal performance criteria in quality engineering
| AD-A198315 | N89-14807
The analysis of averages and the analysis of variance
| AD-A198467 | N89-14809

**ANECHOIC CHAMBERS**
Evaluation of microwave anechoic chamber absorbing materials
| AD-A198055 | N89-14320

**ANELASTICITY**
Anelastic and thermal properties of ethylene/acrylic acid copolymers partially ionized with transition metals
| DE88-017006 | N89-14316

**ANGLE OF ATTACK**
Dynamic stall computations using a zonal Navier-Stokes model
| AD-A197942 | N89-14397
The poststall nonlinear dynamics and control of an F-18: A preliminary investigation N89-14922

**ANGULAR RESOLUTION**
A hard X-ray spectrometer for high angular resolution observations of cosmic sources
| DE88-017005 | N89-15068

**ANISOTROPY**
A viscoplastic constitutive model for anisotropic metals at high temperature N89-14305
Dynamics of unbound vortices in the 2-dimensional XY and anisotropic Heisenberg models
| DE89-000371 | N89-14394

**ANNEALING**
Application of linear response theory to experimental data of simultaneous radiation and annealing response of a CMOS device
| NASA-CR-183401 | N89-14871

**ANNIHILATION REACTIONS**
Pair production and annihilation in gamma-ray bursts N89-15065

**ANNUAL VARIATIONS**
Investigation of radar backscattering from second-year sea ice
| NASA-CR-180986 | N89-14479
Seasonal and temporal changes in the vertical profiles of polar stratospheric ozone: 1978-1986 N89-14513
Ozone profiles above Palmer Station, Antarctica N89-14518
Total ozone, ozone vertical distributions, and stratospheric temperatures at South Pole, Antarctica, in 1986 and 1987 N89-14519
The QBO and interannual variation in total ozone N89-14584
Theoretical study of polar and global ozone changes using a coupled radiative-dynamical 2-D model N89-14590
Comparison of the poleward transport of ozone in the Northern and Southern Hemispheres N89-14591
A two-dimensional model of the quasi biennial oscillation of ozone N89-14596

**ANTARCTIC REGIONS**
Polar Ozone Workshop. Abstracts
| NASA-CP-10014 | N89-14503
Total ozone by lunar Dobson observation at Syowa, Antarctica N89-14504
Total ozone changes in the 1987 Antarctic ozone hole N89-14505
The breakup of the Southern Hemisphere spring polar ozone and temperature minimums from 1979 to 1987 N89-14506
Observations of stratospheric temperature changes coincident with the recent Antarctic ozone depletions N89-14507
Antarctic measurements of ozone, water vapor, and aerosol extinction by Sage 2 in the spring of 1987 N89-14508
The threee-dimensional morphology of the Antarctic ozone hole N89-14509
Estimation of errors in the TOMS total ozone measurement during the Antarctica ozone campaign of August/September 1987 N89-14510
NMC stratospheric analyses during the 1987 Antarctic expedition N89-14511
The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
Ozone profile measurements at McMurdo Station Antarctica during the spring of 1987 N89-14514
Dynamics Explorer 1 SOI images of the Antarctic ozone hole N89-14515
The morphology and meteorology of Southern Hemisphere spring total ozone mini-holes N89-14516
GHOST balloons around Antarctica N89-14517
Ozone profiles above Palmer Station, Antarctica N89-14518
Total ozone, ozone vertical distributions, and stratospheric temperatures at South Pole, Antarctica, in 1986 and 1987 N89-14519
Correlation of N2O and ozone in the Southern Polar vortex during the airborne Antarctic ozone experiment N89-14520
Persistence of Antarctic polar stratospheric clouds N89-14521
Comparison of in situ aerosol measurements with SAGE 2 and SAM 2 aerosol measurements during the airborne Antarctic ozone experiment N89-14522
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
Balloon borne Antarctic frost point measurements and their impact on polar stratospheric cloud theories N89-14524
Large-scale variations in ozone and polar stratospheric clouds measured with airborne lidar during formation of the 1987 ozone hole over Antarctica N89-14525
Filter measurements of chemical composition during the airborne Antarctic ozone experiment N89-14526
Antarctic polar stratospheric aerosols: The roles of nitrates, chlorides and sulfates N89-14527
Ice in the Antarctic polar stratosphere N89-14530
In-situ measurements of total reactive nitrogen, total water vapor, and aerosols in polar stratospheric clouds in the Antarctic stratosphere N89-14531
Extinction and backscatter measurements of Antarctic PSC's, 1987: Implications for particle and vapor removal N89-14532
Evolution of polar stratospheric clouds during the Antarctic winter N89-14534
Heterogeneous chemistry related to Antarctic ozone depletion: Reaction of ClONO2 and N2O5 on ice surfaces N89-14537
Laboratory studies of sticking coefficients and heterogeneous reactions important in the stratosphere N89-14539

Lidar observations of polar stratospheric clouds at McMurdo, Antarctica, during NOZE-2 N89-14540
Observations of condensation nuclei in the 1987 airborne Antarctic ozone experiment N89-14541
Stratospheric column NO2 measurements from three Antarctic sites N89-14542
Ground-based measurements of O3, NO2, OClO, and BrO during the 1987 Antarctic ozone depletion event N89-14543
Near UV atmospheric absorption measurements from the DC-8 aircraft during the 1987 airborne Antarctic ozone experiment N89-14544
Infrared measurements of column amounts of stratospheric constituents in the Antarctic winter, 1987 N89-14545
Infrared measurements in the spring 1987 ozone hole N89-14547
Quantitative observations of the behavior of anomalous low altitude ClO in the Antarctic spring Stratosphere, 1987 N89-14548
Daytime ClO over McMurdo in September 1987: Altitude profile retrieval accuracy N89-14549
Measurements of ozone in the Antarctic region during August and September of 1987 N89-14552
Observations of diurnal variations of BrO and OClO at McMurdo Station, Antarctica (78S) N89-14553
In situ observations of ClO in the Antarctic: Evidence for chlorine catalyzed destruction of ozone N89-14554
Measurements of NO and total reactive odd-nitrogen, NOy, in the Antarctic stratosphere N89-14555
Mixing ratios of trace gases in the austral polar atmosphere during August and September of 1987 N89-14556
Southern Hemispheric nitrous oxide measurements obtained during 1987 airborne Antarctic ozone experiment N89-14557
Observational results of microwave temperature profile measurements from the airborne Antarctic ozone experiment N89-14558
Photochemical trajectory modelling studies of the 1987 Antarctic spring vortex N89-14559
Temperature and horizontal wind measurements on the ER-2 aircraft during the 1987 airborne Antarctic ozone experiment N89-14560
Trace gas measurements from whole air samples collected over the Antarctic continent N89-14561
Synoptic and chemical evolution of the Antarctic vortex in winter and spring, 1987 N89-14563
Dehydration in the lower Antarctic stratosphere in late winter and spring N89-14564
Temporal trends and transport within and around the Antarctic polar vortex during the formation of the 1987 Antarctic ozone hole N89-14565
Small scale structure and mixing at the edge of the Antarctic vortex N89-14566
Transport into the south polar vortex in early spring N89-14567
The evolution of AAOE observed constituents with the polar vortex N89-14568
Photochemical modeling of the Antarctic stratosphere: Observational constraints from the airborne Antarctic ozone experiment and implications for ozone behavior N89-14569
Decending motion of particle and its effect on ozone hole chemistry N89-14570
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic N89-14577
In situ observations of BrO over Antarctica: ER-2 aircraft results from 54 S to 72 S latitude N89-14583
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585
Global impact of the Antarctic ozone hole: Simulations with a 3-D chemical transport model N89-14586
Diagnostic studies of the 1987 Antarctic spring vortex N89-14587
Evolution of the Antarctic polar vortex in spring: Response of a GCM to a prescribed Antarctic ozone hole N89-14589
Radiative aspects of Antarctic ozone hole in 1985 N89-14592
High-resolution dynamical modelling of the Antarctic stratospheric vortex N89-14594
Chemistry of chlorinated species in the Antarctic stratosphere N89-14598
Stability and photochemistry of ClO dimers formed at low temperature in the gas phase N89-14600
Chemistry of the CO dimer at low temperatures N89-14602
Modelling the Antarctic lower stratosphere N89-14603
The chemistry of Antarctic ozone 1960-1987 N89-14604
Modelling the Antarctic ozone hole N89-14605

**ANTENNA ARRAYS**
Antenna arrays with increasing according to arithmetical progression distances between the emitters [AD-A198644] N89-14366

**ANTENNA RADIATION PATTERNS**
A user's manual for the Loaded Microstrip Antenna Code (LMAC) [NASA-CR-184596] N89-14725

**ANTIFERROMAGNETISM**
Nuclear spin cooling using antiferromagnetic magnons N89-14822

**ANTIPROTONS**
Falling antimatter: An experiment to measure the gravitational acceleration of the antiproton [DE89-000313] N89-14892

**ANXIETY**
An inquiry into panic and its differentiation from other types of anxiety N89-14679

**APPROXIMATION**
Impulse response of a frequency-dependent delay [DE88-004793] N89-14368
Approximation methods for the consistent initialization of differential-algebraic equations [DE88-017316] N89-14781
On Hilbert-Schmidt norm convergence of Galerkin approximation for operator Riccati equations [NASA-CR-181755] N89-14798
Semigroups of operators, approximation and saturation in Banach spaces [ETN-89-93353] N89-14813
Semiclassical corrections for inelastic atom-surface scattering from classical trajectories [AD-A198636] N89-14827
Benchmark solutions for the galactic ion transport equations with spatial and energy coupling N89-14907

**ARC MELTING**
Monochromatic imaging studies of a low pressure arc burning on molten Inconel 718 alloy electrodes during vacuum arc remelting [DE88-012855] N89-14292

**ARCHITECTURE**
The computational structural mechanics testbed architecture. Volume 1: The language [NASA-CR-178384] N89-14472
IN-ATE: Fault diagnosis as expert system guided search N89-14757
A generic architecture for knowledge-based equipment fault diagnosis N89-14767
Optical inference machines [AD-A197880] N89-14772

**ARCHITECTURE (COMPUTERS)**
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements [AD-A198656] N89-14367
Man-robot symbiosis: A framework for cooperative intelligence and control [DE89-000430] N89-14687
The birth of the second generation: The Hitachi S-820/80 [DE88-014439] N89-14697
Mass storage system reference model system management [DE88-016325] N89-14698
The NC (Numerically Controlled) assistant: Interfacing knowledge based manufacturing tools to CAO/CAM systems [DE88-016742] N89-14709
Modern computer-aided tools for high-resolution weapons system engineering [AD-A197855] N89-14710
High performance parallel computers for science: New developments at the Fermilab Advanced Computer Program [DE88-016465] N89-14733
Machine intelligence and explication [PB88-204078] N89-14739
GREEDI: The computerization of the DOE/DOD environmental data bank [DE88-014965] N89-14941
Object-oriented systems: An annotated bibliography [NASA-CR-184551] N89-14991

**ARCTIC REGIONS**
Variations of total ozone in the north polar region as seen by TOMS N89-14571
Wintertime losses of ozone in high northern latitudes N89-14572
Observations of stratospheric source gas profiles during the Arctic winter N89-14573
Rocket- and aircraft-borne trace gas measurements in the winter polar stratosphere N89-14574
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic N89-14577
CANOZE measurements of the Arctic ozone hole N89-14578
Brewer spectrophotometer measurements in the Canadian Arctic N89-14579
Zone measurements during wintertime in the Arctic. Comparision with recent measurements at the same places are made. Here the 30 hPa Temperatures are shown N89-14580
Springtime surface ozone fluctuations at high Arctic latitudes and their possible relationship to atmospheric bromine N89-14581
Airborne measurements of tropospheric ozone destruction and particulate bromide formation in the Arctic N89-14582
Turbulence structure of Arctic stratus clouds derived from measurements and simulations [DFVLR-FB-88-29] N89-14633

**ARIANE LAUNCH VEHICLE**
ESA's activities report [ISSN-0258-025X] N99-14937

**ARITHMETIC**
Antenna arrays with increasing according to arithmetical progression distances between the emitters [AD-A198644] N89-14366

**ARMED FORCES (UNITED STATES)**
Human factors in the Naval Air Systems Command: Computer based training [DE88-015301] N89-14686

**ARRAYS**
Monolithic two-dimensional surface-emitting arrays of GaAs/AlGaAs diode lasers N89-14343

**ARTIFICIAL INTELLIGENCE**
Man-robot symbiosis: A framework for cooperative intelligence and control [DE89-000430] N89-14687
Pattern-directed invocation with changing equalities [AD-A198146] N89-14715
Research instrumentation for computer vision, image understanding and optical computing [AD-A198578] N89-14723
Machine intelligence and explication [PB88-204078] N89-14739
Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics [AD-A192453] N89-14740
Expert Missile Maintenance Aid (EMMA): An application of artificial intelligence technology to the munition maintenance domain N89-14748
CEPS: An artificial intelligence approach to avionics maintenance N89-14749
Artificial intelligence technology for the maintainer's associate N89-14752
Avionics fault tree analysis and artificial intelligence for future aircraft maintenance N89-14760
Artificial intelligence in test program development N89-14769
Optical inference machines [AD-A197880] N89-14772
Development and demonstration of Microcomputer Intelligence for Technical Training (MITT) [AD-A197971] N89-14775
Decomposition strategies for eliciting expert knowledge: Judgements of dangerousness [AD-A197913] N89-14936
An overview of the program to place advanced automation and robotics on the Space Station N89-15004

**ARTIFICIAL SATELLITES**
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea [AD-A198653] N89-14484
Effects of electron irradiation on high temperature superconductors and contacts to high temperature superconductors N89-14900
Curriculum in aerospace science and technology in cooperation with NASA Langley Research Center N89-14908

**ASTEROIDS**
Proposed earth-based cratering experiments at low g in hard vacuum N89-15006

**ASTRONOMICAL MODELS**
Kinetics in a turbulent nebular cloud N89-15025
Linear clusters of galaxies N89-15050
CO and IRAS FIR emission in interacting galaxies N89-15058
An investigation of ground-based observations of solar oscillations at Stanford N89-15060
The circumstellar envelopes of young stellar objects and emission line stars N89-15066

**ASTRONOMICAL SPECTROSCOPY**
Multi-object astronomical spectroscopy with optical fibres N89-15048

**ASTROPHYSICS**
Evolution of photon and particle spectra in compact, luminous objects [NASA-TM-101247] N89-14825

Experiments in Planetary and Related Sciences and the Space Station
[NASA-CP-2494] N89-14998
Physics of windblown particles N89-15000
Stellar masses and laboratory astrophysics N89-15056

**ASYMMETRY**
Eye and head motion during head turns in spaceflight
[NASA-TM-100466] N89-14676

**ASYMPTOTIC METHODS**
An asymptotic analysis of a class of nonlinear hyperbolic equations
[ETN-89-93352] N89-14796

**ATLANTIC OCEAN**
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
[AD-A198653] N89-14484
A study of a rapid cyclogenesis event during gale
[AD-A198555] N89-14645

**ATMOSPHERIC BOUNDARY LAYER**
Aerosol characteristics in the Marine Boundary Layer over the Straits of Gibraltar, June 1986
[AD-A197945] N89-14642

**ATMOSPHERIC CHEMISTRY**
The detection and study of molecular species using time resolved laser spectroscopy
[AD-A198482] N89-14285
Polar Ozone Workshop. Abstracts
[NASA-CP-10014] N89-14503
Chemistry of chlorinated species in the Antarctic stratosphere N89-14598
Studies of ClO and BrO reactions important in the polar stratosphere: Kinetics and mechanism of the ClO+BrO and ClO+ClO reactions N89-14599
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product N89-14601
Chemistry of the CO dimer at low temperatures N89-14602
The chemistry of Antarctic ozone 1960-1987 N89-14604
Stratospheric feedback from continued increases in tropospheric methane N89-14606

**ATMOSPHERIC CIRCULATION**
Observations of stratospheric temperature changes coincident with the recent Antarctic ozone depletions N89-14507
GHOST balloons around Antarctica N89-14517
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585
Global impact of the Antarctic ozone hole: Simulations with a 3-D chemical transport model N89-14586
Evolution of the Antarctic polar vortex in spring: Response of a GCM to a prescribed Antarctic ozone hole N89-14589
Theoretical study of polar and global ozone changes using a coupled radiative-dynamical 2-D model N89-14590
Comparison of the poleward transport of ozone in the Northern and Southern Hemispheres N89-14591
High-resolution dynamical modelling of the Antarctic stratospheric vortex N89-14594
Simulation of the transport of halogen species from the equatorial and mid-latitude stratosphere to the polar stratosphere in a two-dimensional model N89-14595
A two-dimensional model of the quasi biennial oscillation of ozone N89-14596
Use of operational analyses to study the dynamics of troposphere-stratosphere interactions in polar regions N89-14597
Dynamical adjustments in the planetary boundary layer N89-14618
Large scale features of the atmospheric water vapor transport over the Amazon Region N89-14620
Long term studies of the refractive index structure parameter in the troposphere and stratosphere
[AD-A198313] N89-14626
Climatology of the Melbourne University general circulation model
[PB88-227491] N89-14638
Some wind characteristics of Kahe Point, O'ahu and vicinity
[AD-A197969] N89-14644
A study of a rapid cyclogenesis event during gale
[AD-A198555] N89-14645
The role of horizontal processes in upper-ocean prediction: A forecast simulation in the Sea of Japan
[AD-A198827] N89-14654

**ATMOSPHERIC COMPOSITION**
Polar Ozone Workshop. Abstracts
[NASA-CP-10014] N89-14503
Total ozone by lunar Dobson observation at Syowa, Antarctica N89-14504
Total ozone changes in the 1987 Antarctic ozone hole N89-14505
Ozone profiles above Palmer Station, Antarctica N89-14518
Total ozone, ozone vertical distributions, and stratospheric temperatures at South Pole, Antarctica, in 1986 and 1987 N89-14519
Correlation of N2O and ozone in the Southern Polar vortex during the airborne Antarctic ozone experiment N89-14520
Comparison of in situ aerosol measurements with SAGE 2 and SAM 2 aerosol measurements during the airborne Antarctic ozone experiment N89-14522
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
Filter measurements of chemical composition during the airborne Antarctic ozone experiment N89-14526
Antarctic polar stratospheric aerosols: The roles of nitrates, chlorides and sulfates N89-14527
On the size and composition of particles in polar stratospheric clouds N89-14528
In-situ measurements of total reactive nitrogen, total water vapor, and aerosols in polar stratospheric clouds in the Antarctic stratosphere N89-14531
Stratospheric column NO2 measurements from three Antarctic sites N89-14542
Near UV atmospheric absorption measurements from the DC-8 aircraft during the 1987 airborne Antarctic ozone experiment N89-14544
Infrared aircraft measurements of stratospheric composition over Antarctica during September 1987 N89-14546
An FTIR spectrometer for remote measurements of atmospheric composition N89-14550
Temporal and spatial distribution of stratospheric trace gases over Antarctica in August and September, 1987 N89-14551
Measurements of ozone in the Antarctic region during August and September of 1987 N89-14552
Observations of diurnal variations of BrO and OClO at McMurdo Station, Antarctica (78S) N89-14553
In situ observations of ClO in the Antarctic: Evidence for chlorine catalyzed destruction of ozone N89-14554
Measurements of NO and total reactive odd-nitrogen, NOy, in the Antarctic stratosphere N89-14555
Springtime surface ozone fluctuations at high Arctic latitudes and their possible relationship to atmospheric bromine N89-14581
In situ observations of BrO over Antarctica: ER-2 aircraft results from 54 S to 72 S latitude N89-14583
The QBO and interannual variation in total ozone N89-14584
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585
Stability and photochemistry of ClO dimers formed at low temperature in the gas phase N89-14600
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product N89-14601
Chemistry of the CO dimer at low temperatures N89-14602
Modelling the Antarctic lower stratosphere N89-14603
Stratospheric feedback from continued increases in tropospheric methane N89-14606
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
[NASA-CR-181724] N89-14896
The effects of biomass burning on the concentration of trace gases in the atmosphere N89-14904

**ATMOSPHERIC MODELS**
Formation of polar stratospheric clouds simulated in a two dimensional model of the atmosphere N89-14529
Evolution of the Antarctic polar vortex in spring: Response of a GCM to a prescribed Antarctic ozone hole N89-14589
High-resolution dynamical modelling of the Antarctic stratospheric vortex N89-14594
Simulation of the transport of halogen species from the equatorial and mid-latitude stratosphere to the polar stratosphere in a two-dimensional model N89-14595
Modelling the Antarctic lower stratosphere N89-14603
Assessing the risks of trace gases that can modify the stratosphere. Volume 7: Technical support documentation atmospheric science papers
[PB88-231089] N89-14612
Scientific evaluation and assessment of ASL developed moist atmosphere models for low stratus subclouds
[AD-A198762] N89-14625
Climatology of the Melbourne University general circulation model
[PB88-227491] N89-14638
Implicit normal-mode initialization of the PSU/NCAR (Pennsylvania State University/National Center for Atmospheric Research) mesoscale model
[PB88-126021] N89-14640
Numerical atmospheric models
[KNMI-TR-107] N89-14649
A study for systematic errors of the GLA forecast model in tropical regions
[NASA-TM-101194] N89-14651

**ATMOSPHERIC MOISTURE**
Large scale features of the atmospheric water vapor transport over the Amazon Region N89-14620

**ATMOSPHERIC OPTICS**
Optical and infrared properties of the marine atmosphere, phase 1
[FEL-1987-76] N89-14630

**ATMOSPHERIC PHYSICS**
Investigations of the dynamics and thermodynamics of the mesosphere and upper thermosphere at the polar regions
[AD-A198463] N89-14627
Daylight and twilight sky radiance and terrestrial irradiance
[AD-A198550] N89-14628
Determination of optical properties by inversion of multiple scattering data: Experimental program
[AD-A198518] N89-14837

**ATMOSPHERIC PRESSURE**
Detection of ions by replacement-ion chromatography coupled to a microwave-induced nitrogen discharge at atmospheric pressure
[AD-A198800] N89-14273
NMC stratospheric analyses during the 1987 Antarctic expedition N89-14511

**ATMOSPHERIC SCATTERING**
Optical and infrared properties of the marine atmosphere, phase 1
[FEL-1987-76] N89-14630

**ATMOSPHERIC TEMPERATURE**
The breakup of the Southern Hemisphere spring polar ozone and temperature minimums from 1979 to 1987 N89-14506
Observations of stratospheric temperature changes coincident with the recent Antarctic ozone depletions N89-14507
NMC stratospheric analyses during the 1987 Antarctic expedition N89-14511
Total ozone, ozone vertical distributions, and stratospheric temperatures at South Pole, Antarctica, in 1986 and 1987 N89-14519
Persistence of Antarctic polar stratospheric clouds N89-14521
Balloon borne Antarctic frost point measurements and their impact on polar stratospheric cloud theories N89-14524
The QBO and interannual variation in total ozone N89-14584
Diagnostic studies of the 1987 Antarctic spring vortex N89-14587
Theoretical study of polar and global ozone changes using a coupled radiative-dynamical 2-D model N89-14590
The chemistry of Antarctic ozone 1960-1987 N89-14604
Retrieval of atmospheric temperatures and gas volume mixing ratios and column amounts from infrared solar absorption spectra
[PB88-236153] N89-14622
Automatic detection of inversions using sodar
[KNMI-TR-106] N89-14631

**ATMOSPHERIC TURBULENCE**
Dynamical adjustments in the planetary boundary layer N89-14618
Turbulence structure of Arctic stratus clouds derived from measurements and simulations
[DFVLR-FB-88-29] N89-14633
Description of the Cabauw (Netherland) turbulence dataset 1977-1979
[KNMI-TR-105] N89-14647

**ATOMIC BEAMS**
Investigation of the hydrogen source for masers
[PB88-225685] N89-14424

**ATOMIC COLLISIONS**
DIMOD program complex for dynamic simulation of defects in metals and alloys
[DE88-703787] N89-14295

**ATOMIC SPECTRA**
A new method for trace metal determinations by monitoring modulated magnetically induced optical rotation in atomic vapours
[AD-A198799] N89-14272
Spontaneous and induced coherent radiation generated in atomic vapor
[AD-A198060] N89-14282

The future of intelligent spectrometers in metal speciation by atomic emission spectrometry
[AD-A198592] N89-14287
The effect of torch pressure on analyte response in a 27 MHz inductively coupled plasma
[AD-A198595] N89-14863

**ATOMS**
Spontaneous and induced coherent radiation generated in atomic vapor
[AD-A198060] N89-14282
Semiclassical corrections for inelastic atom-surface scattering from classical trajectories
[AD-A198636] N89-14827

**AUDITORY PERCEPTION**
Information processing of complex sounds in the anteroventral cochlear nucleus
[AD-A198576] N89-14673
Perceptual factors in workload: A neuromagnetic study
[AD-A198487] N89-14681

**AUDITORY SIGNALS**
Information processing of complex sounds in the anteroventral cochlear nucleus
[AD-A198576] N89-14673

**AUTOMATIC CONTROL**
Automatic speaker recognition system
[AD-A197980] N89-14358
Design of feedback control systems for unstable plants with saturating actuators
[NASA-CR-183392] N89-14377
Automated data acquisition and processing for a Hohlraum reflectometer
[NASA-TM-101393] N89-14416
Automation of a Guinier camera for X-ray diffraction
[ETN-89-93350] N89-14419
Automatic procedure to find corresponding points in CCD Airborne Experimental Scanner for Applications in Remote sensing (CAESAR) images
[B8821609] N89-14490
AEX: Automatic program execution
[PB88-231121] N89-14705
Guidelines for preparation of diagnostic requirements N89-14765
A flight test design for studying airborne applications of air to ground duplex data link communications N89-14924

**AUTOMATIC FREQUENCY CONTROL**
Frequency domain laser velocimeter signal processor
[NASA-CASE-LAR-13552-1-CU] N89-14385

**AUTOMATIC GAIN CONTROL**
Frequency domain laser velocimeter signal processor
[NASA-CASE-LAR-13552-1-CU] N89-14385

**AUTOMATIC TEST EQUIPMENT**
Automated fatigue crack growth measurement
[AD-A198642] N89-14466
On-board expert diagnostics for an avionics subsystem N89-14758
Avionics fault tree analysis and artificial intelligence for future aircraft maintenance N89-14760
MEND: A self-improving diagnostic with deep knowledge N89-14764
A generic architecture for knowledge-based equipment fault diagnosis N89-14767

**AUTOMOBILE ACCIDENTS**
Articulated total body model enhancements. Volume 3: Programmer's guide
[AD-A197940] N89-14688

**AVERAGE**
The analysis of averages and the analysis of variance
[AD-A198467] N89-14809

**AVIONICS**
Spacelab system analysis: A study of communications systems for advanced launch systems
[NASA-CR-183515] N89-14248
Spacelab system analysis: A study of the Marshall Avionics System Testbed (MAST)
[NASA-CR-183516] N89-14354
CEPS: An artificial intelligence approach to avionics maintenance N89-14749
On-board expert diagnostics for an avionics subsystem N89-14758
Avionics fault tree analysis and artificial intelligence for future aircraft maintenance N89-14760

**AXISYMMETRIC FLOW**
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet
[AD-A198360] N89-14399


## B


**B STARS**
The circumstellar envelopes of young stellar objects and emission line stars N89-15066

**B-1 AIRCRAFT**
CEPS: An artificial intelligence approach to avionics maintenance N89-14749
The B-1B central integrated test system expert parameter system N89-14763

**BACKSCATTERING**
Investigation of radar backscattering from second-year sea ice
[NASA-CR-180986] N89-14479
Extinction and backscatter measurements of Antarctic PSC's, 1987: Implications for particle and vapor removal N89-14532
Determination of optical properties by inversion of multiple scattering data: Experimental program
[AD-A198518] N89-14837

**BALANCE**
The 13-inch magnetic suspension and balance system wind tunnel
[NASA-TM-4090] N89-14241

**BALLOON-BORNE INSTRUMENTS**
The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
Ozone profiles above Palmer Station, Antarctica N89-14518
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
Balloon borne Antarctic frost point measurements and their impact on polar stratospheric cloud theories N89-14524

**BALLOONS**
GHOST balloons around Antarctica N89-14517

**BANACH SPACE**
Semigroups of operators, approximation and saturation in Banach spaces
[ETN-89-93353] N89-14813

**BARIUM**
RF surface resistance of YBa2Cu3O(7-x) thin films N89-14347

**BARIUM COMPOUNDS**
Electrochemical synthesis of barium cuprate
[NASA-TT-20327] N89-14271

**BARIUM OXIDES**
Critical fields and characteristic lengths in copper oxide superconductors
[DE89-000543] N89-14872
Magnetic field penetration into the high temperature superconductor YBa2Cu3O(sub 7-x)
[DE89-000547] N89-14873

**BAROCLINITY**
The morphology and meteorology of Southern Hemisphere spring total ozone mini-holes N89-14516

**BARORECEPTORS**
Functional significance and mechanisms of variability in baroreceptor reflex N89-14664

**BARRELS (CONTAINERS)**
Development of strain gage evaluation channels
[DE88-017350] N89-14412

**BATCH PROCESSING**
General specifications for the development of a USL NASA PC R and D statistical analysis support package
[NASA-CR-184537] N89-14977

**BEAM INTERACTIONS**
Molecular beam studies of surface phonons and gas surface interactions
[AD-A198435] N89-14826

**BEAMS (SUPPORTS)**
The influence of and the identification of nonlinearity in flexible structures N89-14932

**BEARINGS**
Some composite bearing and seal materials for gas turbine applications: A review
[NASA-TM-101451] N89-14338
An investigation into fluid film lubrication in dynamically loaded bearings N89-14442
Identification of dynamic parameters of a squeeze-film bearing N89-14443
Tooth contact shift in loaded spiral bevel gears o, IL, 25-27 Apr. 1989; sposored by ASME
[NASA-TM-101438] N89-14453

**BEHAVIOR**
Transient behaviors in chemical reactions: Nanosecond infrared spectroscopy, chemically pumped visible and near-IR lasers
[AD-A198484] N89-14286
Generating tests by exploiting designed behavior N89-14741

**BIAS**
A note on extended quasi-likelihood
[AD-A198042] N89-14805

**BIBLIOGRAPHIES**
Aerospace medicine and biology: A continuing bibliography with indexes
[NASA-SP-7011(318)] N89-14675
The language distribution of bibliographic records in selected online databases N89-14940
A survey of chemical information systems
[NASA-CR-184531] N89-14971
Object-oriented systems: An annotated bibliography
[NASA-CR-184551] N89-14991
Research and technology utilization
[DE88-016749] N89-14996
Technology transfer: Transferring Federal R and D results for domestic commercial utilization
[DE89-000419] N89-14997

**BICRYSTALS**
Grain boundary phase equilibria in metallic systems
[DE89-000026] N89-14294

**BIDIRECTIONAL REFLECTANCE**
Summary of along-track data from the earth radiation budget satellite for several representative ocean regions
[NASA-RP-1206] N89-14634

**BINDERS (MATERIALS)**
Synthesis of energetic single phase and multi-phase polymers
[AD-A198431] N89-14325

**BIOASTRONAUTICS**
Aerospace medicine and biology: A continuing bibliography with indexes
[NASA-SP-7011(318)] N89-14675

**BIOCHEMISTRY**
Introduction of the Proceedings of the Tenth Symposium on Biotechnology for Fuels and Chemicals
[DE88-016361] N89-14667

**BIODEGRADATION**
Simplifying complex QSAR's (Quantitative Structure-Activity Relationships) in toxicity studies with multivariate statistics
[PB88-233937] N89-14614

**BIODYNAMICS**
Articulated total body model enhancements. Volume 1: Modifications
[AD-A198726] N89-14685
Articulated total body model enhancements. Volume 3: Programmer's guide
[AD-A197940] N89-14688

**BIOELECTRIC POTENTIAL**
Circuit behavior in the development of neuronal networks
[AD-A198040] N89-14672

**BIOELECTRICITY**
Circuit behavior in the development of neuronal networks
[AD-A198040] N89-14672

**BIOLOGICAL EFFECTS**
Bio-reactor cell culture process
[NASA-CASE-MSC-21293-1] N89-14666
Aerospace medicine and biology: A continuing bibliography with indexes
[NASA-SP-7011(318)] N89-14675

**BIOLUMINESCENCE**
Firefly luciferase-structure and function
[AD-A198292] N89-14283

**BIOMASS**
The effects of biomass burning on the concentration of trace gases in the atmosphere N89-14904

**BIOTECHNOLOGY**
Bio-reactor cell culture process
[NASA-CASE-MSC-21293-1] N89-14666
Introduction of the Proceedings of the Tenth Symposium on Biotechnology for Fuels and Chemicals
[DE88-016361] N89-14667

**BISMUTH OXIDES**
Bi-Ca-Sr-Cu-O superconductors: The connectivity issue
[DE89-000558] N89-14874

**BITS**
Combining signals of widely differing bit rates on fiber optic subscriber lines
[PB88-210067] N89-14352

**BLACK HOLES (ASTRONOMY)**
Gamma rays from Cygnus X-1: New diagnostics for a black hole
[DE88-016275] N89-15067

**BLANKETS (FUSION REACTORS)**
Helium-3 blankets for tritium breeding in fusion reactors N89-14844
Low activation materials for fusion
[DE88-015561] N89-14854
Review projects for the US Fusion Program
[DE88-017306] N89-14856
High temperature blankets for non-electrical/electrical applications of fusion reactors
[DE88-017307] N89-14857

**BLOOD**
Preliminary estimates of galactic cosmic ray shielding requirements for manned interplanetary missions
[NASA-TM-101516] N89-15070

**BLOOD COAGULATION**
Correction of acute hypoxia-induced changes in blood coagulation in rabbits N89-14663

**BLOOD FLOW**
Cardiovascular system and space environment
[ETN-89-93600] N89-14674

**BLOOD PRESSURE**
Functional significance and mechanisms of variability in baroreceptor reflex N89-14664
**BOLTZMANN DISTRIBUTION**
Study of the discrete models of the Boltzmann equation
| DRET-86-1507/DS/SR | N89-14797
**BOLTZMANN TRANSPORT EQUATION**
Study of the discrete models of the Boltzmann equation
| DRET-86-1507/DS/SR | N89-14797
**BONDING**
Method of insetting predesigned disbond areas into composite laminates
| NASA-CASE-LAR-13225-1 | N89-14258
**BOOSTER ROCKET ENGINES**
Liquid Rocket Booster (LRB) for the Space Transportation System (STS) systems study. Study plan
| NASA-CR-179401 | N89-14249
**BORON**
Oxidation behavior of FeAl + Hf,Zr,B
| NASA-TM-101402 | N89-14297
**BORON NITRIDES**
Boron-nitride preceramic polymer studies
| AD-A197359 | N89-14309
**BOUNDARY ELEMENT METHOD**
Development of BEM for ceramic composites
| NASA-CR-183313 | N89-14311
**BOUNDARY LAYER FLOW**
Two-equation low-Reynolds-number turbulence modeling of transitional boundary layer flows characteristic of gas turbine blades N89-14218
Dynamical adjustments in the planetary boundary layer N89-14618
**BOUNDARY VALUE PROBLEMS**
Numerical analysis of flow through oscillating cascade sections
| NASA-TM-101417 | N89-14220
Determining conductivity by boundary measurements: Some numerical results
| AD-A198014 | N89-14792
An asymptotic analysis of a class of nonlinear hyperbolic equations
| ETN-89-93352 | N89-14796
Modifying PASVART to solve singular nonlinear 2-point boundary problems N89-14906
Disk accretion onto weakly magnetized neutron stars N89-15057
**BRANCHING (MATHEMATICS)**
Modifying PASVART to solve singular nonlinear 2-point boundary problems N89-14906
**BRAZING**
Mechanical properties of dispersion strengthened copper: A comparison of braze cycle annealed and coarse grain microstructures
| DE89-001061 | N89-14296
**BREEDER REACTORS**
Helium-3 blankets for tritium breeding in fusion reactors N89-14844
**BRITTLENESS**
Analysis of ductile-brittle transition temperatures for controlled-rolled, microalloyed, C-Mn-based steels
| AD-A198132 | N89-14298
**BROADBAND**
Combining signals of widely differing bit rates on fiber optic subscriber lines
| PB88-210067 | N89-14352
**BROMIDES**
Airborne measurements of tropospheric ozone destruction and particulate bromide formation in the Arctic N89-14582
Studies of ClO and BrO reactions important in the polar stratosphere: Kinetics and mechanism of the ClO + BrO and ClO + ClO reactions N89-14599
**BROMINE**
Springtime surface ozone fluctuations at high Arctic latitudes and their possible relationship to atmospheric bromine N89-14581
The effect of pyridostigmine bromine on inflight aircrew performance
| AD-A198828 | N89-14670
**BROMINE COMPOUNDS**
Observations of diurnal variations of BrO and OClO at McMurdo Station, Antarctica (78S) N89-14553
In situ observations of BrO over Antarctica: ER-2 aircraft results from 54 S to 72 S latitude N89-14583
**BROWNIAN MOVEMENTS**
Sunset over Brownistan
| AD-A198443 | N89-14814
**BUBBLES**
Discussion and explanation of unplanned ignition incident: Ignition caused by rapid pressurization of a propellant containing bubbles
| AD-A198419 | N89-14340
**BUCKLING**
Modifying PASVART to solve singular nonlinear 2-point boundary problems N89-14906
**BUNDLES**
Data acquisition and control for multiple composite life tests
| AD-A198395 | N89-14263
**BY-PRODUCTS**
Application of inductively coupled plasma atomic emission spectroscopy analysis with a polychromator/monochromator combination the byproducts of coal-fired power stations
| PB88-226535 | N89-14838

## C

**CADMIUM TELLURIDES**
Ternary solid phase equilibria in the systems (Ag,In,Au)-(Cd,He)-Te
| AD-A198679 | N89-14302
Crystal growth of CdTe in space and thermal field effects on mass flux and morphology
| NASA-CR-183263 | N89-14868
**CALCIUM OXIDES**
Bi-Ca-Sr-Cu-O superconductors: The connectivity issue
| DE89-000558 | N89-14874
**CALCULUS OF VARIATIONS**
Dynamics of structures: Fundamentals
| DE88-017027 | N89-14462
**CALIBRATING**
Possible measurement errors in calibrated AVHRR (Advanced Very High Resolution Radiometer) data
| AD-A198342 | N89-14414
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
| AD-A198653 | N89-14484
Estimation of errors in the TOMS total ozone measurement during the Antarctica ozone campaign of August/September 1987 N89-14510
The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
Seasonal and temporal changes in the vertical profiles of polar stratospheric ozone: 1978-1986 N89-14513
Ozone profile measurements at McMurdo Station Antarctica during the spring of 1987 N89-14514
A national intercomparison of hydrophone calibration methods
| NPL-AC-116 | N89-14819
Report on OTHER proposals for SSPEX N89-15003
**CALORIMETERS**
Low temperature heat capacities of several high strength materials
| AD-A198300 | N89-14299
**CAMERAS**
Automation of a Guinier camera for X-ray diffraction
| ETN-89-93350 | N89-14419
**CAMOUFLAGE**
Radar Cross Section (RCS) reduction techniques for square trihedral corner reflectors at 35 GHz: Measurements and theoretical simulations
| FEL-1988-04 | N89-14365
**CANADA**
Brewer spectrophotometer measurements in the Canadian Arctic N89-14579
**CANONICAL FORMS**
Computation of canonical correlation and best predictable aspect of future for time series
| NASA-CR-184655 | N89-14810
**CANOPIES (VEGETATION)**
Determination of soil moisture beneath a stalk or trunk dominated canopy
| NASA-CR-183322 | N89-14621
**CANTILEVER BEAMS**
Shaker shock testing using nonstationary random transients
| DE88-015847 | N89-14460
**CAPILLARY FLOW**
Capillary heat transport and fluid management device
| NASA-CASE-MFS-28217-1 | N89-14392
**CARBON**
The effect of high heating rate on the pyrolysis of polymeric and composite materials
| AD-A198052 | N89-14319
User's guide for executing OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms, version 4) with CBM-4 (Carbon-Bond Mechanism-4)
| PB88-221965 | N89-14609
**CARBON DIOXIDE**
Pretreatment of CO oxidation catalysts N89-14930
**CARBON DIOXIDE CONCENTRATION**
The precise determination of the refractive index of air
| NPL-MOM-90 | N89-14629
**CARBON FIBERS**
Polymer powder prepregging: Scoping study N89-14926
**CARBON STEELS**
Analysis of ductile-brittle transition temperatures for controlled-rolled, microalloyed, C-Mn-based steels
| AD-A198132 | N89-14298
**CARBON-CARBON COMPOSITES**
Statistical characterization of carbon phenolic prepreg materials, volume 1
| NASA-CR-179416 | N89-14306
**CARBONACEOUS CHONDRITES**
Electrical conductivity of carbonaceous chondrites and electric heating of meteorite parent bodies N89-15011
Electrical conductivity of chondritic meteorites N89-15012
Crystal-liquid-vapor equilibrium experiments at high temperature (less than or equal to 1800 C) and low, controlled oxygen and hydrogen pressure (10(-1) to 10(-9) PA) N89-15028
Experimental constraints on heating and cooling rates of refractory inclusions in the early solar system N89-15042
**CARBORANE**
The synthesis of carborane-oxetane monomers and their polymerization
| AD-A198596 | N89-14330
**CARDIOVASCULAR SYSTEM**
Systemic hemodynamic shifts in hypoxia N89-14665
Cardiovascular system and space environment
| ETN-89-93600 | N89-14674
**CARRIER LIFETIME**
Hg,CdTe material optimization for carrier lifetime maximization
| AD-A198101 | N89-14880
**CASCADE FLOW**
Numerical analysis of flow through oscillating cascade sections
| NASA-TM-101417 | N89-14220
**CASTING**
Castable hot corrosion resistant alloy
| NASA-CASE-LEW-14134-2 | N89-14303
**CASTINGS**
Improved foundry castings utilizing CAD/CAM (Computer Aided Design/Computer Aided Manufacture). Volume 1: Overview
| AD-A198067 | N89-14712
**CASUALTIES**
Articulated total body model enhancements. Volume 3: Programmer's guide
| AD-A197940 | N89-14688
**CATALYSTS**
Measurement and prediction of mass transfer in solid catalysts N89-14267
A solar photochemical process for destroying organics in water
| DE89-000503 | N89-14277
A spectroscopic characterization of the structure of supported metal catalysts
| B8811777 | N89-14889
Pretreatment of CO oxidation catalysts N89-14930
**CAVITATION FLOW**
A finite difference analysis of the heat transfer in periodic cavity flows N89-14389
Navier-Stokes calculations of transonic flows past cavities
| NASA-CR-4210 | N89-14401
**CAVITIES**
Passive venting technique for shallow cavities
| NASA-CASE-LAR-14031-1 | N89-14232
Passive venting technique for shallow cavities
| NASA-CASE-LAR-13875-1 | N89-14233
Circumferential pressure probe
| NASA-CASE-LAR-13775-1 | N89-14408
Development of an endoscopic probe for radial metrology
| NASA-CR-184577 | N89-14417
**CAVITY RESONATORS**
Transverse effects of a waveguide coupling slot
| DE89-000340 | N89-14356
High-power microwave source development at Los Alamos
| DE89-000327 | N89-14830
**CELLS (BIOLOGY)**
Bio-reactor cell culture process
| NASA-CASE-MSC-21293-1 | N89-14666
**CENTER OF PRESSURE**
Optimization of slender wings for center-of-pressure shift due to change in Mach number N89-14897
**CERAMIC BONDING**
Bonding of metal-ceramic interfaces in hybrid materials
| AD-A197928 | N89-14261
**CERAMIC COATINGS**
Boron-nitride preceramic polymer studies
| AD-A197359 | N89-14309

Multilayer plasma coats used as thermal barrier in engines
| ETN-89-93598 | N89-14333

**CERAMIC FIBERS**
Boron-nitride preceramic polymer studies
| AD-A197359 | N89-14309

**CERAMIC MATRIX COMPOSITES**
Mechanical property enhancement in ceramic matrix composites
| PB88-232863 | N89-14257
Development of BEM for ceramic composites
| NASA-CR-183313 | N89-14311
A review of failure models for unidirectional ceramic matrix composites under monotonic loads
| NASA-TM-101421 | N89-14470

**CERAMICS**
Ceramics: Materials for severe environments
| PB88-240049 | N89-14308
Study of high temperature failure mechanisms in ceramics
| AD-A198375 | N89-14324
Composite ceramic superconducting filaments for superconducting cable
| AD-A198657 | N89-14888

**CHAINS**
Rheological studies on blends of rodlike and flexible chain polymers
| AD-A198455 | N89-14326

**CHANNEL NOISE**
Random access algorithms for multiuser computer communication networks
| AD-A198090 | N89-14713

**CHANNELS (DATA TRANSMISSION)**
Spacelab system analysis: A study of communications systems for advanced launch systems
| NASA-CR-183515 | N89-14248
Processor and data bus interface analyses
| AD-A198801 | N89-14696

**CHARACTERIZATION**
Aircraft emissions characterization
| AD-A197864 | N89-14617
Some test/analysis issues for the space station structural characterization experiment N89-14901

**CHARGE CARRIERS**
Hg,CdTe material optimization for carrier lifetime maximization
| AD-A198101 | N89-14880
Transport and junction physics of semiconductor-metal eutectic composites
| AD-A198480 | N89-14884

**CHARGE COUPLED DEVICES**
Molecular spectroscopy using charge transfer device detectors
| AD-A198593 | N89-14288
Comparison of charge transfer device and photomultiplier tube performance for extremely low photon fluxes
| AD-A198594 | N89-14382
CCD polarimetry as a probe of regions of recent star-formation N89-15054

**CHARGE TRANSFER**
The future of intelligent spectrometers in metal speciation by atomic emission spectrometry
| AD-A198592 | N89-14287
Molecular spectroscopy using charge transfer device detectors
| AD-A198593 | N89-14288
Comparison of charge transfer device and photomultiplier tube performance for extremely low photon fluxes
| AD-A198594 | N89-14382

**CHARGE TRANSFER DEVICES**
Molecular spectroscopy using charge transfer device detectors
| AD-A198593 | N89-14288
Comparison of charge transfer device and photomultiplier tube performance for extremely low photon fluxes
| AD-A198594 | N89-14382

**CHARGED PARTICLES**
Field tests and experiments on visibility modification
| AD-A197956 | N89-14643

**CHARTS**
Polygons, stars, and clusters: An investigation of polygon displays
| AD-A198430 | N89-14719

**CHELATES**
Studies of metal beta-diketonates by reversed-phase high performance liquid chromatography N89-14268
Gas chromatographic and spectroscopic studies of cobalt(II) and other selected transition metal chelates of tetradentate beta-ketoenamines N89-14269

**CHEMICAL ANALYSIS**
Chemical and Laser Sciences Division
| DE88-017140 | N89-14274
Trace analysis by capillary gas chromatography: Theory and methods
| B8811770 | N89-14289
Statistical characterization of carbon phenolic prepreg materials, volume 1
| NASA-CR-179416 | N89-14306
Polysilylated unsaturated molecules
| AD-A198492 | N89-14328
VAMAS surface chemical analysis standard data transfer format with skeleton decoding programs
| NPL-DMA(A)-164 | N89-14724

**CHEMICAL BONDS**
Vibration spectra of silica near 2400 K: Measurement and molecular dynamics simulation
| DE88-015925 | N89-14314
Reactions of metal ions and their clusters in the gas phase using laser ionization-Fourier transform mass spectrometry
| DE88-017281 | N89-14431
User's guide for executing OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms, version 4) with CBM-4 (Carbon-Bond Mechanism-4)
| PB88-221965 | N89-14609

**CHEMICAL COMPOSITION**
The development of iron-aluminium based alloys for aqueous corrosion resistance N89-14291
Experimental correlation of melt structures, nucleation rates, and thermal histories of silicate melts N89-15044
Scientific results of the NASA-sponsored study project on Mars: Evolution of its climate and atmosphere
| NASA-TM-101207 | N89-15059

**CHEMICAL DEFENSE**
The effect of pyridostigmine bromine on inflight aircrew performance
| AD-A198828 | N89-14670

**CHEMICAL ELEMENTS**
A survey of chemical information systems
| NASA-CR-184531 | N89-14971

**CHEMICAL EQUILIBRIUM**
Crystal-liquid-vapor equilibrium experiments at high temperature (less than or equal to 1800 C) and low, controlled oxygen and hydrogen pressure (10(-1) to 10(-9) PA) N89-15028

**CHEMICAL EVOLUTION**
Synoptic and chemical evolution of the Antarctic vortex in winter and spring, 1987 N89-14563

**CHEMICAL PROPERTIES**
A survey of chemical information systems
| NASA-CR-184531 | N89-14971

**CHEMICAL REACTIONS**
Aerodynamic and kinetic processes in flames
| AD-A198474 | N89-14284
Transient behaviors in chemical reactions: Nanosecond infrared spectroscopy, chemically pumped visible and near-IR lasers
| AD-A198484 | N89-14286
Heterogeneous physicochemistry of the winter polar stratosphere N89-14535
The chemistry of Antarctic ozone 1960-1987 N89-14604
Modelling the Antarctic ozone hole N89-14605
Simplifying complex QSAR's (Quantitative Structure-Activity Relationships) in toxicity studies with multivariate statistics
| PB88-233937 | N89-14614
Chemical variability in ocean frontal areas
| AD-A198418 | N89-14655
Volatiization-devolatilization reactions N89-15014

**CHEMICAL REACTORS**
A solar photochemical process for destroying organics in water
| DE89-000503 | N89-14277

**CHEMICAL TESTS**
Iodine sorption study on the proposed use of Viton A in a shuttle galley water accumulator
| NASA-TM-100467 | N89-14691

**CHEMILUMINESCENCE**
Development of laser-excited molecular luminescence spectrometric methods for aromatic hydrocarbons
| DE88-017305 | N89-14276

**CHIPS (ELECTRONICS)**
Expert system on a chip: An engine for real-time approximate reasoning N89-14771

**CHIRP**
Chirped pulse amplification: Present and future
| DE89-001016 | N89-14434

**CHLORIDES**
Antarctic polar stratospheric aerosols: The roles of nitrates, chlorides and sulfates N89-14527

**CHLORINE**
Adsorption of chlorine on clean and on oxygen pre-exposed Al(3)
| AD-A198005 | N89-14280
In situ observations of ClO in the wintertime Northern Hemisphere: ER-2 aircraft results from 21 N to 61 N latitude N89-14575
Chemistry of chlorinated species in the Antarctic stratosphere N89-14598

**CHLORINE COMPOUNDS**
In situ observations of ClO in the Antarctic: Evidence for chlorine catalyzed destruction of ozone N89-14554
Studies of ClO and BrO reactions important in the polar stratosphere: Kinetics and mechanism of the ClO + BrO and ClO + ClO reactions N89-14599
Stability and photochemistry of ClO dimers formed at low temperature in the gas phase N89-14600
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product N89-14601
Chemistry of the CO dimer at low temperatures N89-14602
High resolution FTIR spectroscopy of the ClO radical N89-14607

**CHLORINE OXIDES**
Quantitative observations of the behavior of anomalous low altitude ClO in the Antarctic spring Stratosphere, 1987 N89-14548
Daytime ClO over McMurdo in September 1987: Altitude profile retrieval accuracy N89-14549
Observations of diurnal variations of BrO and OClO at McMurdo Station, Antarctica (78S) N89-14553

**CHLOROFLUOROMETHANE**
Laboratory studies of sticking coefficients and heterogeneous reactions important in the stratosphere N89-14539

**CHONDRITES**
Volatilization-fractionation of silicates related to chondrite composition N89-15036

**CHONDRULE**
Dynamic crystallization experiments on chondrule melts in reduced gravity N89-15023
Experimental constraints on the origin of chondrules N89-15043

**CHROMATOGRAPHY**
Detection of ions by replacement-ion chromatography coupled to a microwave-induced nitrogen discharge at atmospheric pressure
| AD-A198800 | N89-14273

**CIRCUIT BOARDS**
Transverter assembly for the advanced instrumentation radar
| DE89-001036 | N89-14357

**CIRCUIT DIAGRAMS**
Adaptable pulsed analog-to-digital converter
| DE88-703778 | N89-14701

**CIRCUIT RELIABILITY**
Generating tests by exploiting designed behavior N89-14741

**CIRCUITS**
Design of fault-tolerant circuits for photovoltaic concentrators
| DE89-001062 | N89-14379
Circuit behavior in the development of neuronal networks
| AD-A198040 | N89-14672

**CIRCULATORY SYSTEM**
Systemic hemodynamic shifts in hypoxia N89-14665

**CIRCUMFERENCES**
Circumferential pressure probe
| NASA-CASE-LAR-13775-1 | N89-14408

**CLADDING**
Composite ceramic superconducting filaments for superconducting cable
| AD-A198657 | N89-14888

**CLASSICAL MECHANICS**
The computational structural mechanics testbed architecture. Volume 1: The language
| NASA-CR-178384 | N89-14472

**CLASSIFICATIONS**
Classification and analysis of surface and clouds at high latitudes from AVHRR multispectral satellite data N89-14635
Cloud classification from satellite data using a fuzzy sets algorithm: A polar example
| NASA-CR-184568 | N89-14708
Texture-based cloud classification N89-14931
CO and IRAS FIR emission in interacting galaxies N89-15058

**CLIMATE**
Scientific results of the NASA-sponsored study project on Mars: Evolution of its climate and atmosphere
| NASA-TM-101207 | N89-15059

**CLIMATOLOGY**
Climatology of the Melbourne University general circulation model
| PB88-227491 | N89-14638

**CLOCKS**
Laser clocks and near field gravity of rotating objects N89-14911

**CLOUD COVER**
Space shuttle large format camera photography cloud cover interference diagrams
[PB88-244405] N89-14482
Daylight and twilight sky radiance and terrestrial irradiance
[AD-A198550] N89-14628
Classification and analysis of surface and clouds at high latitudes from AVHRR multispectral satellite data N89-14635
Cloud classification from satellite data using a fuzzy sets algorithm: A polar example
[NASA-CR-184568] N89-14708
Texture-based cloud classification N89-14931
**CLOUD PHYSICS**
Balloon borne Antarctic frost point measurements and their impact on polar stratospheric cloud theories N89-14524
Turbulence structure of Arctic stratus clouds derived from measurements and simulations
[DFVLR-FB-88-29] N89-14633
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899
**CLOUDS**
Extinction and backscatter measurements of Antarctic PSC's, 1987: Implications for particle and vapor removal N89-14532
Evolution of polar stratospheric clouds during the Antarctic winter N89-14534
Heterogeneous physicochemistry of the winter polar stratosphere N89-14535
Physical processes in polar stratospheric ice clouds N89-14536
Heterogeneous chemistry related to Antarctic ozone depletion: Reaction of ClONO2 and N2O5 on ice surfaces N89-14537
Mass accommodation coefficient measurements for HNO3, HCl and N2O5 on water, ice and aqueous sulfuric acid droplet surfaces N89-14538
Lidar observations of polar stratospheric clouds at McMurdo, Antarctica, during NOZE-2 N89-14540
Observations of condensation nuclei in the 1987 airborne Antarctic ozone experiment N89-14541
The design and protocol of a summertime rainfall enhancement program for West Texas N89-14636
**CLOUDS (METEOROLOGY)**
Persistence of Antarctic polar stratospheric clouds N89-14521
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
Balloon borne Antarctic frost point measurements and their impact on polar stratospheric cloud theories N89-14524
Large-scale variations in ozone and polar stratospheric clouds measured with airborne lidar during formation of the 1987 ozone hole over Antarctica N89-14525
On the size and composition of particles in polar stratospheric clouds N89-14528
Formation of polar stratospheric clouds simulated in a two dimensional model of the atmosphere N89-14529
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899
Texture-based cloud classification N89-14931
**CLUSTER ANALYSIS**
On exceedance point processes for stationary sequences under mild oscillation restrictions
[AD-A198314] N89-14806
Simulation studies for surfaces and materials strength
[NASA-CR-183378] N89-14824
**CMOS**
Application of linear response theory to experimental data of simultaneous radiation and annealing response of a CMOS device
[NASA-CR-183401] N89-14871
**COAL**
Application of inductively coupled plasma atomic emission spectroscopy analysis with a polychromator/monochromator combination the byproducts of coal-fired power stations
[PB88-226535] N89-14838
**COBALT**
Gas chromatographic and spectroscopic studies of cobalt(II) and other selected transition metal chelates of tetradentate beta-ketoenamines N89-14269
**COCKPITS**
Sound attenuation and speech transmission quality of five types of headsets
[IZF-1987-23] N89-14373
**COGNITION**
Base rate effects on the interpretation of probability and frequency expressions
[AD-A198456] N89-14808
**COHERENT RADIATION**
Spontaneous and induced coherent radiation generated in atomic vapor
[AD-A198060] N89-14282
**COLLISION AVOIDANCE**
Comparison of the general dynamics ground clobber algorithm with the GCAS and laws algorithms
[AD-A198479] N89-14226
**COLLOCATION**
A study on least-squares prediction and collocation --- geodesy
[ETN-89-93336] N89-14492
Single-grid spectral collocation for the Navier-Stokes equations
[NASA-CR-181754] N89-14799
**COMBUSTION**
Dynamic combustion studies using advanced optical diagnostics. Volume 2: Tabulated data
[AD-A198025] N89-14281
The effects of biomass burning on the concentration of trace gases in the atmosphere N89-14904
**COMBUSTION CHAMBERS**
Dynamic combustion studies using advanced optical diagnostics. Volume 2: Tabulated data
[AD-A198025] N89-14281
Development of a rotary valve for pulse combustion applications
[PB88-250568] N89-14444
**COMETS**
Ultraviolet spectroscopy of meteoric debris: In situ calibration experiments from earth orbit N89-15031
How to make a comet N89-15035
**COMMONALITY**
Space station commonality analysis
[NASA-CR-179422] N89-14251
**COMMUNICATION NETWORKS**
Network management of highly adaptive communication networks
[AD-A198429] N89-14362
STU-3 system level description and network applications, revision
[AD-A198514] N89-14363
Random access algorithms for multiuser computer communication networks
[AD-A198090] N89-14713
Northeast Artificial Intelligence Consortium annual report 1986. Volume 3: Distributed artificial intelligence for communication network management
[AD-A197957] N89-14774
**COMMUTATORS**
Analogs of Clifford algebra for forms above quadratic and their matrix realization
[DE88-703748] N89-14787
**COMPARISON**
Variations of total ozone in the north polar region as seen by TOMS N89-14571
**COMPARTMENTS**
Fire extinguishing agent evaluation in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS)
[AD-A198523] N89-14227
**COMPATIBILITY**
Orbit transfer rocket engine technology program: Oxygen materials compatibility testing
[NASA-CR-182195] N89-14256
**COMPLETENESS**
An example of a harmonizable process whose spectral domain is not complete
[NASA-CR-184653] N89-14800
**COMPLEX SYSTEMS**
A generic expert diagnostician N89-14750
Active information retrieval
[PB88-226642] N89-14938
**COMPONENT RELIABILITY**
The nature of the aircraft component failure process: A working note
[AD-A197979] N89-14234
**COMPOSITE MATERIALS**
Graphite fluoride fiber polymer composite material
[NASA-CASE-LEW-14472-1] N89-14259
Creep behavior of an Al2O3-SiC composite
[DE88-014553] N89-14260
Analytical and experimental characterization of damage processes in composite laminates
[AD-A198068] N89-14262
Composite foams
[DE89-000368] N89-14315
The effect of high heating rate on the pyrolysis of polymeric and composite materials
[AD-A198052] N89-14319
Some composite bearing and seal materials for gas turbine applications: A review
[NASA-TM-101451] N89-14338
**COMPOSITE STRUCTURES**
Method of inserting predesigned disbond areas into composite laminates
[NASA-CASE-LAR-13225-1] N89-14258
Response of composite plates subjected to acoustic loading
[NASA-CR-184618] N89-14469
**COMPRESSED GAS**
Discussion and explanation of unplanned ignition incident: Ignition caused by rapid pressurization of a propellant containing bubbles
[AD-A198419] N89-14340
**COMPRESSIBLE FLOW**
Underexpanded noncondensing turbulent gas jets in liquids
[AD-A197939] N89-14396
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet
[AD-A198360] N89-14399
**COMPRESSION LOADS**
Tooth contact shift in loaded spiral bevel gears o, IL, 25-27 Apr. 1989; sposored by ASME
[NASA-TM-101438] N89-14453
**COMPRESSOR EFFICIENCY**
Advanced core technology: Key to subsonic propulsion benefits
[NASA-TM-101420] N89-14237
**COMPUTATION**
Electromagnetic time-domain calculations in two and three dimensions
[DE89-000311] N89-14355
Antenna arrays with increasing according to arithmetical progression distances between the emitters
[AD-A198644] N89-14366
Application developer's tutorial for the CSM testbed architecture
[NASA-CR-181732] N89-14473
The CSM testbed matrix processors internal logic and dataflow descriptions
[NASA-CR-181742] N89-14474
On the origin of steep edges and filaments in vorticity and potential vorticity fields N89-14593
Computation of algebraic polynomial parametric surface intersections
[PB88-208277] N89-14778
A general expression of Jacobian matrix and its simplified computation method: Relationships between the velocities of manipulator hand and joints
[DE88-754808] N89-14782
Finite-difference methods for solution of the many-dimensional nonlinear Schroedinger equation
[DE88-703772] N89-14788
Computation of canonical correlation and best predictable aspect of future for time series
[NASA-CR-184655] N89-14810
Numerical methods for turbulent flow N89-14928
**COMPUTATIONAL FLUID DYNAMICS**
Numerical analysis of flow through oscillating cascade sections
[NASA-TM-101417] N89-14220
Turbofan forced mixer lobe flow modeling. 1: Experimental and analytical assessment
[NASA-CR-4147-PT-1] N89-14221
Turbofan forced mixer lobe flow modeling. 2: Three-dimensional inviscid mixer analysis (FLOMIX)
[NASA-CR-4147-PT-2] N89-14222
Coupled three-dimensional conduction and natural convection heat transfer N89-14388
Development of the general interpolants method for the CYBER 200 series of supercomputers
[NASA-CR-4183] N89-14704
Universal limiter for transient interpolation modeling of the advective transport equations: The ULTIMATE conservative difference scheme
[NASA-TM-100916] N89-14794
Study of the discrete models of the Boltzmann equation
[DRET-86-1507/DS/SR] N89-14797
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight
[NASA-CR-4212] N89-14821
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
[NASA-CR-181724] N89-14896
An investigation of turbulence models N89-14905
Approaches to non-linear aerodynamic analysis and design N89-14909
Overlapping grids for flow field calculations N89-14918
**COMPUTATIONAL GRIDS**
Numerical grid generation and potential airfoil analysis and design
[AD-A197972] N89-14219
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight
[NASA-CR-4212] N89-14821
Approaches to non-linear aerodynamic analysis and design N89-14909

Overlapping grids for flow field calculations
N89-14918

**COMPUTER AIDED DESIGN**
Numerical grid generation and potential airfoil analysis and design
[AD-A197972] N89-14219
A preliminary report on developing an expert system for computer-aided formulation of propellants
[AD-A198088] N89-14339
Finite element electromagnetic scattering: An interactive micro-computer algorithm
[AD-A198552] N89-14364
The NC (Numerically Controlled) assistant: Interfacing knowledge based manufacturing tools to CAO/CAM systems
[DE88-016742] N89-14709
Improved foundry castings utilizing CAD/CAM (Computer Aided Design/Computer Aided Manufacture). Volume 1: Overview
[AD-A198067] N89-14712
DEH (Directorates of Engineering and Housing) automated graphics guide: Selection, acquisition, implementation, and management
[AD-A198489] N89-14721
Investigation and selection of an interactive graphics aid for the analysis and design phase. Report on the project ISOO-03
[AD-1987-1121] N89-14728
Expert system rules from CAD databases N89-14756
B-spline-Bezier representation of tau-splines
[AD-A197937] N89-14791

**COMPUTER AIDED MANUFACTURING**
The NC (Numerically Controlled) assistant: Interfacing knowledge based manufacturing tools to CAO/CAM systems
[DE88-016742] N89-14709
Improved foundry castings utilizing CAD/CAM (Computer Aided Design/Computer Aided Manufacture). Volume 1: Overview
[AD-A198067] N89-14712

**COMPUTER AIDED MAPPING**
Make-map and MEDMAP: Two programs for plotting maps of the Mediterranean Sea
[AD-A198491] N89-14483

**COMPUTER ANIMATION**
Design and implementation of a supercomputer frame buffer system
[DE88-007834] N89-14703

**COMPUTER ASSISTED INSTRUCTION**
Development and demonstration of Microcomputer Intelligence for Technical Training (MITT)
[AD-A197971] N89-14775

**COMPUTER GRAPHICS**
Coupled three-dimensional conduction and natural convection heat transfer N89-14388
Make-map and MEDMAP: Two programs for plotting maps of the Mediterranean Sea
[AD-A198491] N89-14483
Development and use of interactive displays in real-time ground support research facilities
[NASA-TM-101694] N89-14683
DEH (Directorates of Engineering and Housing) automated graphics guide: Selection, acquisition, implementation, and management
[AD-A198489] N89-14721
Investigation and selection of an interactive graphics aid for the analysis and design phase. Report on the project ISOO-03
[AD-1987-1121] N89-14728
Computer modeling of polymers N89-14910

**COMPUTER NETWORKS**
VAMAS surface chemical analysis standard data transfer format with skeleton decoding programs
[NPL-DMA(A)-164] N89-14724
Running a large Monte Caplo Program in a farm of MicroVAX-II computers under VAXELIN
[DE88-012761] N89-14732
Evaluation of work distribution algorithms and hardware topologies in a multi-transputer network
[AD-A198530] N89-14736
Numbering of new elements for net refinement
[NASA-TT-20435] N89-14737
Interactive access to scientific and technological factual databases worldwide
[DE88-016172] N89-14943
Resident database interfaces to the DAVID system, a heterogeneous distributed database management system
[NASA-CR-184615] N89-14946
The USL NASA PC R and D development environment standards
[NASA-CR-184535] N89-14975
General specifications for the development of a USL/DBMS NASA/PC R and D distributed workstation
[NASA-CR-184538] N89-14978
IBM PC/IX operating system evaluation plan
[NASA-CR-184546] N89-14986

**COMPUTER PROGRAMMING**
Articulated total body model enhancements. Volume 3: Programmer's guide
[AD-A197940] N89-14888
AEX: Automatic program execution
[PB88-231121] N89-14705
Synthesis of graphical displays for tabular data
[AD-A198979] N89-14707
RADC (Rome Air Development Center) system/software requirements engineering testbed research and development program
[AD-A197858] N89-14711
USL/DBMS NASA/PC R and D project C programming standards
[NASA-CR-184543] N89-14983
USL/DBMS NASA/PC R and D project system design standards
[NASA-CR-184544] N89-14984
A programming environment evaluation methodology for object-oriented systems
[NASA-CR-184552] N89-14992

**COMPUTER PROGRAMS**
Plotting component maps in the Navy/NASA Engine Program (NNEP): A method and its usage
[NASA-TM-101433] N89-14239
Analysis of electrophoresis performance
[NASA-CR-183508] N89-14265
DIMOD program complex for dynamic simulation of defects in metals and alloys
[DE88-703787] N89-14295
Development of BEM for ceramic composites
[NASA-CR-183313] N89-14311
A preliminary report on developing an expert system for computer-aided formulation of propellants
[AD-A198088] N89-14339
Electromagnetic time-domain calculations in two and three dimensions
[DE89-000311] N89-14355
Heat exchanger optimization N89-14391
Digital image analysis system for monitoring crack growth at elevated temperature
[AD-A198649] N89-14468
Variance components estimation in two dimensional geodetic networks
[ETN-89-93332] N89-14489
Daylight and twilight sky radiance and terrestrial irradiance
[AD-A198550] N89-14628
The design and protocol of a summertime rainfall enhancement program for West Texas N89-14636
Implicit normal-mode initialization of the PSU/NCAR (Pennsylvania State University/National Center for Atmospheric Research) mesoscale model
[PB88-126021] N89-14640
AEX: Automatic program execution
[PB88-231121] N89-14705
Composing data and process descriptions in the design of software systems
[AD-A198096] N89-14714
Investigation and selection of an interactive graphics aid for the analysis and design phase. Report on the project ISOO-03
[AD-1987-1121] N89-14728
Exploration in the field of expert systems. Report on the project Expert 01
[AD-1967-1271] N89-14729
An evaluation of five PC-based expert system shells
[AD-A197915] N89-14773
Computational methods and software for differential equations and their applications
[DE89-000025] N89-14783
The analysis of averages and the analysis of variance
[AD-A198467] N89-14809
Detailed design specification for a prototype Assessment System for Aircraft Noise (ASAN)
[AD-A197936] N89-14818
Users' manual for the Langley high speed propeller noise prediction program (DFP-ATP)
[NASA-CR-4208] N89-14820
Evolution of photon and particle spectra in compact, luminous objects
[NASA-TM-101247] N89-14825
Macromolecular calculations in the XTAL system of crystallographic programs
[AD-A198525] N89-14886
An investigation of turbulence models N89-14905
Modeling of transitional flows N89-14917
Knowledge based systems: A preliminary survey of selected issues and techniques
[NASA-CR-184513] N89-14953
The USL NASA PC R and D project: General specifications of objectives
[NASA-CR-184534] N89-14974
General specifications for the development of a USL NASA PC R and D statistical analysis support package
[NASA-CR-184537] N89-14977
USL/DBMS NASA/PC R and D project system testing standards
[NASA-CR-184545] N89-14985
A programming environment evaluation methodology for object-oriented systems
[NASA-CR-184552] N89-14992

**COMPUTER STORAGE DEVICES**
Mass storage system reference model system management
[DE88-016325] N89-14698
Robust algorithms for detecting a change in a stochastic process with infinite memory
[AD-A198290] N89-14716

**COMPUTER SYSTEMS DESIGN**
Investigation and selection of an interactive graphics aid for the analysis and design phase. Report on the project ISOO-03
[AD-1987-1121] N89-14728
High performance parallel computers for science: New developments at the Fermilab Advanced Computer Program
[DE88-016465] N89-14733
Queuing network models and performance analysis of computer systems
[B8811769] N89-14738
Machine intelligence and explication
[PB88-204078] N89-14739
Expert systems to give installation advice for UNIX 4.2BSD and to help connect a terminal to a computer N89-14755
Natural language query system design for interactive information storage and retrieval systems. Presentation visuals
[NASA-CR-184526] N89-14966
Some issues in data model mapping
[NASA-CR-184528] N89-14968
A methodology for the design and evaluation of user interfaces for interactive information systems
[NASA-CR-184532] N89-14972
General specifications for the development of a USL/DBMS NASA/PC R and D distributed workstation
[NASA-CR-184538] N89-14978
Design criteria for a PC-based common user interface to remote information systems
[NASA-CR-184541] N89-14981
USL/DBMS NASA/PC R and D project system design standards
[NASA-CR-184544] N89-14984
PC-based Multiple Information System Interface (PC/MISI) design plan
[NASA-CR-184547] N89-14987
PC-based Multiple Information System Interface (PC/MISI) detailed design and implementation plan
[NASA-CR-184548] N89-14988

**COMPUTER SYSTEMS PERFORMANCE**
Mass storage system reference model system management
[DE88-016325] N89-14698
A methodology for the design and evaluation of user interfaces for interactive information systems
[NASA-CR-184532] N89-14972
General specifications for the development of a PC-based simulator of the NASA RECON system
[NASA-CR-184536] N89-14976
A performance evaluation of the IBM 370/XT personal computer
[NASA-CR-184542] N89-14982
USL/DBMS NASA/PC R and D project system design standards
[NASA-CR-184544] N89-14984
IBM PC/IX operating system evaluation plan
[NASA-CR-184546] N89-14986
An overview of the evaluation plan for PC/MISI: PC-based Multiple Information System Interface
[NASA-CR-184549] N89-14989

**COMPUTER SYSTEMS PROGRAMS**
Description of the network method and the simulation package simulation based on networks (SIMONE)
[IWECO-5176814-87-1] N89-14730
A software package for sequential quadratic programming
[DFVLR-FB-28-28] N89-14731

**COMPUTER TECHNIQUES**
A preliminary report on developing an expert system for computer-aided formulation of propellants
[AD-A198088] N89-14339
Finite element electromagnetic scattering: An interactive micro-computer algorithm
[AD-A198552] N89-14364
Modern computer-aided tools for high-resolution weapons system engineering
[AD-A197855] N89-14710

Fault-tolerant distributed algorithms for agreement and election
[AD-A198416] N89-14718
Exploration in the field of expert systems. Report on the project Expert 01
[AD-1987-1271] N89-14729
A generic expert diagnostician N89-14750
Optical inference machines
[AD-A197880] N89-14772
The analysis of averages and the analysis of variance
[AD-A198467] N89-14809

**COMPUTER VISION**
Research instrumentation for computer vision, image understanding and optical computing
[AD-A198578] N89-14723

**COMPUTERIZED SIMULATION**
Analysis of electrophoresis performance
[NASA-CR-183508] N89-14265
Dynamic combustion studies using advanced optical diagnostics. Volume 2: Tabulated data
[AD-A198025] N89-14281
DIMOD program complex for dynamic simulation of defects in metals and alloys
[DE88-703787] N89-14295
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet
[AD-A198360] N89-14399
High-power AlGaAs channeled substrate planar diode lasers for spaceborne communications
[NASA-CR-4189] N89-14426
Dynamics of structures: Fundamentals
[DE88-017027] N89-14462
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585
High-resolution dynamical modelling of the Antarctic stratospheric vortex N89-14594
A microcomputer pollution model for civilian airports and air force bases, model description
[AD-A199003] N89-14616
Articulated total body model enhancements. Volume 1: Modifications
[AD-A198726] N89-14685
Articulated total body model enhancements. Volume 3: Programmer's guide
[AD-A197940] N89-14688
A split-Levinson approach to autoregressive modeling
[AD-A198535] N89-14722
Numerical simulation of injection molding: Non-isothermal non-Newtonian flow of polymers in complex geometries
[ETN-89-93348] N89-14727
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight
[NASA-CR-4212] N89-14821
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
[NASA-CR-181724] N89-14896
Benchmark solutions for the galactic ion transport equations with spatial and energy coupling N89-14907
Modeling of transitional flows N89-14917
Evaluation of the pseudo pilot effect on baseline controller study data N89-14920
Grain dynamics in zero gravity N89-15038
Nonlinear magnetic reconnection N89-15052

**COMPUTERS**
Ordering methods for sparse matrices and vector computers
[AD-A198291] N89-14717

**CONCATENATED CODES**
A concatenated coded modulation scheme for error control (addition 2)
[NASA-CR-183260] N89-14706

**CONCENTRATION (COMPOSITION)**
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product N89-14601

**CONCENTRATORS**
Design of fault-tolerant circuits for photovoltaic concentrators
[DE89-001062] N89-14379

**CONDENSING**
Laboratory studies of HNO3/H2O mixtures at low temperatures N89-14533
Mass accommodation coefficient measurements for HNO3, HCl and N2O5 on water, ice and aqueous sulfuric acid droplet surfaces N89-14538
Observations of condensation nuclei in the 1987 airborne Antarctic ozone experiment N89-14541
Particle formation and interaction N89-15001
Kinetics of mineral condensation in the solar nebula N89-15019
Nucleation and particle coagulation experiments in microgravity N89-15030

**CONDUCTIVITY**
Coupled three-dimensional conduction and natural convection heat transfer N89-14388

**CONFERENCES**
Polar Ozone Workshop. Abstracts
[NASA-CP-10014] N89-14503
Introduction of the Proceedings of the Tenth Symposium on Biotechnology for Fuels and Chemicals
[DE88-016361] N89-14667
Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics
[AD-A192453] N89-14740
USL NASA/RECON project presentations at the 1985 ACM Computer Science Conference: Abstracts and visuals
[NASA-CR-184522] N89-14962
Experiments in Planetary and Related Sciences and the Space Station
[NASA-CP-2494] N89-14998
Experimental cosmochemistry in the Space Station N89-15002

**CONFIGURATION MANAGEMENT**
Reconfigurable flight control: An opportunity for integrated diagnostics N89-14744

**CONFORMAL MAPPING**
Superconformal algebras in two dimensions
[DE88-703786] N89-14790

**CONSISTENCY**
A note on extended quasi-likelihood
[AD-A198042] N89-14805

**CONSTRAINTS**
Photochemical modeling of the Antarctic stratosphere: Observational constraints from the airborne Antarctic ozone experiment and implications for ozone behavior N89-14569

**CONSTRUCTION MATERIALS**
Characterization study of the structural bonding system EA 9680 (EA 9645). Test report 1/R/86
[REPT-1/R/86] N89-14334

**CONSUMABLES (SPACECREW SUPPLIES)**
Space shuttle food system summary, 1981-1986
[NASA-TM-100469] N89-14693

**CONTACT LOADS**
Tooth contact shift in loaded spiral bevel gears o, IL, 25-27 Apr. 1989; sposored by ASME
[NASA-TM-101438] N89-14453

**CONTAINERLESS MELTS**
Experimental correlation of melt structures, nucleation rates, and thermal histories of silicate melts N89-15044
Containerless high-pressure petrology experiments in the microgravity environment of the Space Station N89-15045

**CONTAMINANTS**
Advanced concepts for contaminant resistant fuel cells
[DE88-017151] N89-14496
Statistical model of environmental contaminants using variance spectrum analysis
[PB88-235130] N89-14615
Iodine sorption study on the proposed use of Viton A in a shuttle galley water accumulator
[NASA-TM-100467] N89-14691
Modeling of hydrogen-air diffusion flame N89-14913

**CONTINENTS**
Trace gas measurements from whole air samples collected over the Antarctic continent N89-14561

**CONTINUITY**
B-spline-Bezier representation of tau-splines
[AD-A197937] N89-14791

**CONTOURS**
On the use of 1-D finite elements for the temperature behavior of a contoured and partially plated SC-Cut resonator
[AD-A198309] N89-14882

**CONTRACT NEGOTIATION**
Program solicitation closing date: July 22, 1988
[NASA-TM-101217] N89-14934

**CONTRACTION**
Influence of emotional-pain stress on contractile function of myocardium during long-term hypokinesia N89-14662

**CONTRACTS**
PROMIS (Procurement Management Information System)
[NASA-CR-179395] N89-14933
Program solicitation closing date: July 22, 1988
[NASA-TM-101217] N89-14934

**CONTRAST**
Further investigation of contrast sensitivity and visual acuity in pilot detection of aircraft
[AD-A198434] N89-14680

**CONTROL EQUIPMENT**
Controlled sample orientation and rotation in an acoustic levitator
[NASA-CASE-NPO-17086-1-CU] N89-14422
A system for conducting igneous petrology experiments under controlled redox conditions in reduced gravity N89-15040

**CONTROL STABILITY**
Controlled sample orientation and rotation in an acoustic levitator
[NASA-CASE-NPO-17086-1-CU] N89-14422

**CONTROL SYSTEMS DESIGN**
Design of feedback control systems for unstable plants with saturating actuators
[NASA-CR-183392] N89-14377

**CONTROLLERS**
The poststall nonlinear dynamics and control of an F-18: A preliminary investigation N89-14922

**CONVECTION**
An advanced study of natural convection immersion cooling of a 3 x 3 array of simulated components in an enclosure filled with dielectric liquid
[AD-A197962] N89-14398
Semi-prognostic tests of cumulus parameterization schemes in the middle latitudes
[PB88-236013] N89-14639

**CONVECTION CURRENTS**
Large scale features of the atmospheric water vapor transport over the Amazon Region N89-14620

**CONVECTIVE HEAT TRANSFER**
Coupled three-dimensional conduction and natural convection heat transfer N89-14388
An advanced study of natural convection immersion cooling of a 3 x 3 array of simulated components in an enclosure filled with dielectric liquid
[AD-A197962] N89-14398

**CONVERGENCE**
Determination of convergence rates across the Ventura Basin, Southern California, using GPS and historical triangulation
[NASA-CR-183014] N89-14624
Numerical schemes in the stabilization method for nonlinear differential equations of second order
[DE88-703773] N89-14789
On Hilbert-Schmidt norm convergence of Galerkin approximation for operator Riccati equations
[NASA-CR-181755] N89-14798

**COOLING**
Ionization rates relevant to laser cooling of hydrogen
[AD-A198481] N89-14440
Experimental constraints on heating and cooling rates of refractory inclusions in the early solar system N89-15042

**COOLING SYSTEMS**
Capillary heat transport and fluid management device
[NASA-CASE-MFS-28217-1] N89-14392
An advanced study of natural convection immersion cooling of a 3 x 3 array of simulated components in an enclosure filled with dielectric liquid
[AD-A197962] N89-14398

**COPOLYMERS**
Anelastic and thermal properties of ethylene/acrylic acid copolymers partially ionized with transition metals
[DE88-017006] N89-14316
Synthesis of energetic single phase and multi-phase polymers
[AD-A198431] N89-14325
The synthesis of carborane-oxetane monomers and their polymerization
[AD-A198596] N89-14330

**COPPER ALLOYS**
Mechanical properties of dispersion strengthened copper: A comparison of braze cycle annealed and coarse grain microstructures
[DE89-001061] N89-14296

**COPPER COMPOUNDS**
Electrochemical synthesis of barium cuprate
[NASA-TT-20327] N89-14271

**COPPER OXIDES**
RF surface resistance of YBa2Cu3O(7-x) thin films N89-14347
Critical fields and characteristic lengths in copper oxide superconductors
[DE89-000543] N89-14872
Magnetic field penetration into the high temperature superconductor YBa2Cu3O(sub 7-x)
[DE89-000547] N89-14873

**CORE FLOW**
Effects of core turbulence on jet excitability
[NASA-TM-101405] N89-14403

**CORIOLIS EFFECT**
Low-gravity facilities for Space Station planetology experiments N89-15032

**CORRELATION**
Correlation of N2O and ozone in the Southern Polar vortex during the airborne Antarctic ozone experiment N89-14520
Computation of canonical correlation and best predictable aspect of future for time series
[NASA-CR-184655] N89-14810

**CORRELATION COEFFICIENTS**
Correlation of N2O and ozone in the Southern Polar vortex during the airborne Antarctic ozone experiment N89-14520
**CORROSION**
Adsorption of chlorine on clean and on oxygen pre-exposed Al(3)
|AD-A198005| N89-14280
**CORROSION PREVENTION**
Influence of the application parameters of primer coats for bonding. Test report 49-064/F
|REPT-49-064/F| N89-14336
**CORROSION RESISTANCE**
The development of iron-aluminium based alloys for aqueous corrosion resistance N89-14291
Castable hot corrosion resistant alloy
|NASA-CASE-LEW-14134-2| N89-14303
**COSMIC DUST**
Cosmic dust collection with a sub satellite tethered to a Space Station N89-15010
**COSMIC RAY SHOWERS**
Modelling of central density spectra of extensive air showers from primary particles with E = 10(sup 2)-10(sup 7) GeV
|DE88-703728| N89-15069
**COSMOCHEMISTRY**
Experimental cosmochemistry in the Space Station N89-15002
Kinetics in a turbulent nebular cloud N89-15025
**COSMONAUTS**
Current achievements in cosmonautics
|NASA-TT-20365| N89-14245
**COST EFFECTIVENESS**
DEH (Directorates of Engineering and Housing) automated graphics guide: Selection, acquisition, implementation, and management
|AD-A198489| N89-14721
The FIS electronics troubleshooting system N89-14742
**COUNTER ROTATION**
Eye and head motion during head turns in spaceflight
|NASA-TM-100466| N89-14676
**COUPLINGS**
Transverse effects of a waveguide coupling slot
|DE89-000340| N89-14356
**COVARIANCE**
On the connection of geodetic point fields in Reseau European Trigonometrique (RETRIG) and related tests for model errors
|ETN-89-93327| N89-14485
A study on least-squares prediction and collocation --- geodesy
|ETN-89-93336| N89-14492
Connected part of the covariant Tate p-divisible group and the zeta-function of the family of hyperelliptic curves y sup 2 = 1 + mu(chi sup N) modulo various primes
|PB88-226659| N89-14777
**CRACK PROPAGATION**
Cyclic deformation, damage, and effects of environment in the Ni3Al ordered alloy at elevated temperatures
|AD-A198500| N89-14300
Study of high temperature failure mechanisms in ceramics
|AD-A198375| N89-14324
Mechanical reliability of piezoelectric and dielectric ceramics
|AD-A198458| N89-14327
A unified model for predicting the stress and strain distributions around cracks of any length, including elastic, plastic, creep and cyclic deformation N89-14455
Development of a microcircuit grid technique for automated crack length measurement for fatigue testing at elevated temperature
|AD-A198003| N89-14463
The influence of porosity on short fatigue crack growth at large strain amplitudes
|AD-A198477| N89-14464
Automated fatigue crack growth measurement
|AD-A198642| N89-14466
Digital image analysis system for monitoring crack growth at elevated temperature
|AD-A198649| N89-14468
Fatigue evolution of small two and three dimensional cracks under variable and constant amplitude loading
|MM-AL/AP-04-88| N89-14471
**CRACKS**
Mechanical property enhancement in ceramic matrix composites
|PB88-232863| N89-14257
Fracture behaviour under impact 2
|AD-A198643| N89-14467
**CRASHES**
Comparison of the general dynamics ground clobber algorithm with the GCAS and laws algorithms
|AD-A198479| N89-14226
Articulated total body model enhancements. Volume 3: Programmer's guide
|AD-A197940| N89-14688
**CRATERING**
Planetary impact experimentation N89-14999
Proposed earth-based cratering experiments at low g in hard vacuum N89-15006
Impact cratering in reduced-gravity environments: Early experiments on the NASA KC-135 aircraft N89-15008
Low-gravity impact experiments: Progress toward a facility definition N89-15009
**CRATONS**
Numerical optimization
|AD-A198586| N89-14793
**CREEP PROPERTIES**
Creep behavior of an Al2O3-SiC composite
|DE88-014553| N89-14260
Two-bar thermal ratchetting of annealed 2.25Cr-1Mo steel N89-14304
**CREEP RUPTURE STRENGTH**
Data acquisition and control for multiple composite life tests
|AD-A198395| N89-14263
**CREEP TESTS**
Study of high temperature failure mechanisms in ceramics
|AD-A198375| N89-14324
The viscoplastic behavior of SCS6/Ti-15-3 metal matrix composite materials at elevated temperatures N89-14929
**CRITERIA**
Working fluid selection for space-based two-phase heat transport systems
|NASA-CR-183324| N89-14390
**CRITICAL TEMPERATURE**
Dynamics of unbound vortices in the 2-dimensional XY and anisotropic Heisenberg models
|DE89-000371| N89-14394
**CROP INVENTORIES**
Analysis of crop loss for alternative ozone exposure indices
|PB88-214788| N89-14608
**CROP VIGOR**
Analysis of crop loss for alternative ozone exposure indices
|PB88-214788| N89-14608
**CRUCIBLES**
Effects of crucible wetting during solidification of immiscible Pb-Zn
|NASA-TM-101372| N89-14341
**CRYOGENIC TEMPERATURE**
Cryogenic thermometers based on TVO type resistors and their application
|DE88-703755| N89-14413
**CRYSTAL DEFECTS**
DIMOD program complex for dynamic simulation of defects in metals and alloys
|DE88-703787| N89-14295
**CRYSTAL GROWTH**
Crystal growth of CdTe in space and thermal field effects on mass flux and morphology
|NASA-CR-183263| N89-14868
Diamond chemical vapor deposition apparatus
|NASA-TT-20380| N89-14870
Experimental studies of crystal-melt differentiation in planetary basalt compositions N89-15018
Containerless high-pressure petrology experiments in the microgravity environment of the Space Station N89-15045
**CRYSTAL OPTICS**
Preparation, structure, and spectroscopic properties of nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 crystals
|AD-A198476| N89-14883
**CRYSTAL STRUCTURE**
Macromolecular calculations in the XTAL system of crystallographic programs
|AD-A198525| N89-14886
Nucleation and particle coagulation experiments in microgravity N89-15030
**CRYSTAL SURFACES**
On the use of 1-D finite elements for the temperature behavior of a contoured and partially plated SC-Cut resonator
|AD-A198309| N89-14882
**CRYSTALLINITY**
Variable temperature solid state NMR of side-chain crystalline comb polymers
|AD-A198099| N89-14322
Crystalline silicon photovoltaic cell technology: Meeting the challenge for utility power
|DE89-000439| N89-14500
**CRYSTALLIZATION**
Variable temperature solid state NMR of side-chain crystalline comb polymers
|AD-A198099| N89-14322
Dynamic crystallization experiments on chondrule melts in reduced gravity N89-15023
**CRYSTALLOGRAPHY**
A spectroscopic characterization of the structure of supported metal catalysts
|B8811777| N89-14889
**CRYSTALS**
Variable temperature solid state NMR of side-chain crystalline comb polymers
|AD-A198099| N89-14322
Residual infrared absorption in Ti:Al2O3 crystals N89-14345
Ice in the Antarctic polar stratosphere N89-14530
Spectroscopic investigation of the Cr to Tm energy transfer in Yttrium Aluminum Garnet (YAG) crystals N89-14903
**CULTURE TECHNIQUES**
Bio-reactor cell culture process
|NASA-CASE-MSC-21293-1| N89-14666
**CUMULUS CLOUDS**
Semi-prognostic tests of cumulus parameterization schemes in the middle latitudes
|PB88-236013| N89-14639
**CURRENT ALGEBRA**
Superconformal algebras in two dimensions
|DE88-703786| N89-14790
**CURVES**
Connected part of the covariant Tate p-divisible group and the zeta-function of the family of hyperelliptic curves y sup 2 = 1 + mu(chi sup N) modulo various primes
|PB88-226659| N89-14777
**CYCLIC HYDROCARBONS**
Development of laser-excited molecular luminescence spectrometric methods for aromatic hydrocarbons
|DE88-017305| N89-14276
Synthesis of new polynitropolyhedranes
|AD-A198320| N89-14323
**CYCLIC LOADS**
Analysis of shell-type structures subjected to time-dependent mechanical and thermal loading
|NASA-CR-183005| N89-14457
**CYCLOGENESIS**
A study of a rapid cyclogenesis event during gale
|AD-A198555| N89-14645
**CYCLONES**
A study of a rapid cyclogenesis event during gale
|AD-A198555| N89-14645
**CYCLOTRON RESONANCE DEVICES**
High-power microwave source development at Los Alamos
|DE89-000327| N89-14830
**CYGNUS CONSTELLATION**
Gamma rays from Cygnus X-1: New diagnostics for a black hole
|DE88-016275| N89-15067
**CYLINDRICAL BODIES**
Improvement in finite element meshes: Heat transfer in an infinite cylinder
|NASA-TM-101410| N89-14450

## D

**DAMAGE**
Analytical and experimental characterization of damage processes in composite laminates
|AD-A198068| N89-14262
Cyclic deformation, damage, and effects of environment in the Ni3Al ordered alloy at elevated temperatures
|AD-A198500| N89-14300
Use of time-resolved techniques for studying shock-induced vaporization
|DE88-017168| N89-14395
Extension and validation of a method for locating damaged members in large space trusses N89-14925
**DAMPING**
Identification of dynamic parameters of a squeeze-film bearing N89-14443
**DATA ACQUISITION**
Equipment to upgrade the facilities of the IIT (Illinois Institute of Technology) Fluid Dynamics Research Center
|AD-A198084| N89-14242
Data acquisition and control for multiple composite life tests
|AD-A198395| N89-14263
Automated data acquisition and processing for a Hohlraum reflectometer
|NASA-TM-101393| N89-14416
Shock response spectrum anomalies which occur due to imperfections in the data
|DE88-015846| N89-14459
The evolution of AAOE observed constituents with the polar vortex N89-14568

Kiruna geophysical data: Data summary Oct. - Dec. 1987
| PB88-236633 | N89-14623
The data collection component of the Hanford Meteorology Monitoring Program
| DE89-000404 | N89-14641
The JNC-16: A 16-channel data acquisition and analysis module
| DE88-017200 | N89-14699
High speed data acquisition systems
| AD-A198194 | N89-14735
Evaluation of the pseudo pilot effect on baseline controller study data N89-14920

**DATA BASE MANAGEMENT SYSTEMS**
ELEFUNT test results under FORTRAN-PLUS on the active memory technology DAP 510-8
| DE88-017264 | N89-14700
CD-ROM (Compact Disc Read Only Memory) library of the future
| AD-A197943 | N89-14702
PROMIS (Procurement Management Information System)
| NASA-CR-179395 | N89-14933
Active information retrieval
| PB88-226642 | N89-14938
Interactive access to scientific and technological factual databases worldwide
| DE88-016172 | N89-14943
Self-adaptive databases
| AD-A197883 | N89-14944
Resident database interfaces to the DAVID system, a heterogeneous distributed database management system
| NASA-CR-184615 | N89-14946
USL/DBMS NASA/RECON working paper series. Standards
| NASA-CR-184508 | N89-14948
Overview of the NASA/RECON educational, research, and development activities of the Computer Science Departments of the University of Southwestern Louisiana and Southern University
| NASA-CR-184509 | N89-14949
Knowledge based systems: A critical survey of major concepts, issues and techniques. Visuals
| NASA-CR-184518 | N89-14958
An innovative, multidisciplinary educational program in interactive information storage and retrieval. Presentation visuals
| NASA-CR-184521 | N89-14961
An overview of the USL/DBMS NASA/PC R and D project working paper series
| NASA-CR-184533 | N89-14973
General specifications for the development of a USL/DBMS NASA/PC R and D distributed workstation
| NASA-CR-184538 | N89-14978
Data bases: Management of complex data structures using the semantic data model
| REPT-88-34 | N89-14993

**DATA BASES**
Dynamic combustion studies using advanced optical diagnostics. Volume 2: Tabulated data
| AD-A198025 | N89-14281
A microcomputer pollution model for civilian airports and air force bases, model description
| AD-A199003 | N89-14616
Kiruna geophysical data: Data summary Oct. - Dec. 1987
| PB88-236633 | N89-14623
Description of the Cabauw (Netherland) turbulence dataset 1977-1979
| KNMI-TR-105 | N89-14647
Expert system rules from CAD databases N89-14756
The language distribution of bibliographic records in selected online databases N89-14940
GREEDI: The computerization of the DOE/DOD environmental data bank
| DE88-014965 | N89-14941
DOE/DOD environmental data bank
| DE88-015262 | N89-14942
Interactive access to scientific and technological factual databases worldwide
| DE88-016172 | N89-14943
Description of the RSG-10 noise data base --- speech recognition/communication
| IZF-1988-03 | N89-14945
A survey of chemical information systems
| NASA-CR-184531 | N89-14971
NASA PC software evaluation project
| NASA-CR-184550 | N89-14990
Data bases: Management of complex data structures using the semantic data model
| REPT-88-34 | N89-14993

**DATA LINKS**
A flight test design for studying airborne applications of air to ground duplex data link communications N89-14924

**DATA MANAGEMENT**
The computational structural mechanics testbed architecture. Volume 1: The language
| NASA-CR-178384 | N89-14472

**DATA PROCESSING**
Laser Doppler velocimeter multiplexer interface for simultaneous measured events
| NASA-CASE-ARC-11536-1 | N89-14384
Automated data acquisition and processing for a Hohlraum reflectometer
| NASA-TM-101393 | N89-14416
The CSM testbed matrix processors internal logic and dataflow descriptions
| NASA-CR-181742 | N89-14474
TIROS/NOAA (television and infrared observation satellite/National Oceanic and Atmospheric Administration) satellites space environment monitor archive tape documentation, 1988 update
| PB88-224613 | N89-14619
The influence of grazing on land surface climatological variables
| NASA-CR-183308 | N89-14637
User's guide for the Nimbus 7 Scanning Multichannel Microwave Radiometer (SMMR) CELL-ALL tape
| NASA-RP-1210 | N89-14648
The JNC-16: A 16-channel data acquisition and analysis module
| DE88-017200 | N89-14699
A split-Levinson approach to autoregressive modeling
| AD-A198535 | N89-14722
An overview of selected information storage and retrieval issues in computerized document processing
| NASA-CR-184519 | N89-14959

**DATA REDUCTION**
Knowledge-based analysis of telemetry data on the Hubble space telescope N89-14751

**DATA STORAGE**
On 3480 class tape cartridge drives and archival data storage: Technology assessment report
| PB88-233135 | N89-14939
An overview of selected information storage and retrieval issues in computerized document processing
| NASA-CR-184519 | N89-14959
An innovative, multidisciplinary educational program in interactive information storage and retrieval
| NASA-CR-184520 | N89-14960
An innovative, multidisciplinary educational program in interactive information storage and retrieval. Presentation visuals
| NASA-CR-184521 | N89-14961
USL NASA/RECON project presentations at the 1985 ACM Computer Science Conference: Abstracts and visuals
| NASA-CR-184522 | N89-14962
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems
| NASA-CR-184523 | N89-14963
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems. Presentation visuals
| NASA-CR-184524 | N89-14964
Natural language query system design for interactive information storage and retrieval systems
| NASA-CR-184525 | N89-14965
Natural language query system design for interactive information storage and retrieval systems. Presentation visuals
| NASA-CR-184526 | N89-14966

**DATA STRUCTURES**
Synthesis of graphical displays for tabular data
| AD-A198979 | N89-14707
Data bases: Management of complex data structures using the semantic data model
| REPT-88-34 | N89-14993

**DATA SYSTEMS**
Composing data and process descriptions in the design of software systems
| AD-A198096 | N89-14714
Some issues in data model mapping
| NASA-CR-184528 | N89-14968

**DATA TRANSFER (COMPUTERS)**
Optical fiber data transfer system
| NASA-CR-181704 | N89-14376

**DATA TRANSMISSION**
Design of error control coding schemes for three problems of noisy information transmission, storage and processing
| B8811768 | N89-14371
A concatenated coded modulation scheme for error control (addition 2)
| NASA-CR-183260 | N89-14706
VAMAS surface chemical analysis standard data transfer format with skeleton decoding programs
| NPL-DMA(A)-164 | N89-14724
Radiation-induced transient absorption in single mode optical fibers
| DE89-000392 | N89-14832

**DAYTIME**
Daytime ClO over McMurdo in September 1987: Altitude profile retrieval accuracy N89-14549
Daylight and twilight sky radiance and terrestrial irradiance
| AD-A198550 | N89-14628

**DEBRIS**
Ultraviolet spectroscopy of meteoric debris: In situ calibration experiments from earth orbit N89-15031

**DECISION MAKING**
Fitting of Meteosat information into meteorological decision making
| KNMI-TR-108 | N89-14650
Base rate effects on the interpretation of probability and frequency expressions
| AD-A198456 | N89-14808
The use of think aloud verbal protocols for the identification of mental models
| DE88-015180 | N89-14935
Decomposition strategies for eliciting expert knowledge: Judgements of dangerousness
| AD-A197913 | N89-14936
Technology transfer: Transferring Federal R and D results for domestic commercial utilization
| DE89-000419 | N89-14997

**DECISION THEORY**
An evaluation of five PC-based expert system shells
| AD-A197915 | N89-14773
Decomposition strategies for eliciting expert knowledge: Judgements of dangerousness
| AD-A197913 | N89-14936

**DEFECTS**
DIMOD program complex for dynamic simulation of defects in metals and alloys
| DE88-703787 | N89-14295

**DEFENSE PROGRAM**
CD-ROM (Compact Disc Read Only Memory) library of the future
| AD-A197943 | N89-14702

**DEFLECTION**
Tooth contact shift in loaded spiral bevel gears o, IL, 25-27 Apr. 1989; sposored by ASME
| NASA-TM-101438 | N89-14453

**DEFORMATION**
Cyclic deformation, damage, and effects of environment in the Ni3Al ordered alloy at elevated temperatures
| AD-A198500 | N89-14300
Quantitative holographic interferometry: Measurement of solid object deformations
| ETN-89-93351 | N89-14420
Holographic recording of deformation waves in muscle tissue N89-14660
Acoustic phonon scattering in modulation doped Aluminum (subx) Gallium (sub 1x) Arsenide/Gallium arsenide heterojunctions
| AD-A198512 | N89-14885

**DEHYDRATION**
Ice in the Antarctic polar stratosphere N89-14530
Dehydration in the lower Antarctic stratosphere in late winter and spring N89-14564

**DEICERS**
Evaluation of the improved OV-1D anti-icing system
| AD-A198438 | N89-14225
A numerical simulation of the full two-dimensional electrothermal de-icer pad
| NASA-CR-4194 | N89-14235

**DELAMINATING**
Method of insetting predesigned disbond areas into composite laminates
| NASA-CASE-LAR-13225-1 | N89-14258

**DELAY**
Impulse response of a frequency-dependent delay
| DE88-004793 | N89-14368

**DELTA WINGS**
Investigation of a moving-model technique for measuring ground effect
| NASA-TM-4080 | N89-14217

**DEPOSITION**
Electrostatic aggregation of finely-comminuted geological materials N89-15027

**DEPTH MEASUREMENT**
Ultrasonic depth gauge for liquids under high pressure
| NASA-CASE-LAR-13300-1-CU | N89-14407

**DESIGN ANALYSIS**
The 13-inch magnetic suspension and balance system wind tunnel
| NASA-TM-4090 | N89-14241
ETX-I: First-generation single-shaft electric propulsion system program. Volume 2: Battery
| DE89-000079 | N89-14378
Heat exchanger optimization N89-14391

Semiconductor laser diodes and the design of a D.C. powered laser diode drive unit
[AD-A198556] N89-14441
System for the optimum design of structures
[ETN-89-93599] N89-14451
Design sensitivity analysis and optimization of nonlinear structures: A unified approach
[PB88-235171] N89-14458
Generating tests by exploiting designed behavior N89-14741
Incorporating design for test into an IC design expert system N89-14746

**DETECTION**
Detection of ions by replacement-ion chromatography coupled to a microwave-induced nitrogen discharge at atmospheric pressure
[AD-A198800] N89-14273
The detection and study of molecular species using time resolved laser spectroscopy
[AD-A198482] N89-14285
Molecular spectroscopy using charge transfer device detectors
[AD-A198593] N89-14288
Automatic detection, tracking and sensor integration
[AD-A198347] N89-14361
Comparison of charge transfer device and photomultiplier tube performance for extremely low photon fluxes
[AD-A198594] N89-14362

**DETERIORATION**
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
[AD-A198361] N89-14439

**DEUTERIUM**
Laser-driven polarized sources of hydrogen and deuterium
[DE89-000541] N89-14432
Status of fusion research and implications for D/He-3 systems N89-14845
Strategy for D/He-3 fusion development N89-14846
Synergism of He-3 acquisition with lunar base evolution N89-14852

**DIAGNOSIS**
Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics
[AD-A192453] N89-14740
The FIS electronics troubleshooting system N89-14742
Reasoning about multiple faults N89-14743
Reconfigurable flight control: An opportunity for integrated diagnostics N89-14744
The integrated diagnostic support system N89-14745
The integrated diagnostic model: Towards a second generation diagnostic expert system N89-14747
A generic expert diagnostician N89-14750
A flight expert system (FLES) for on-board fault monitoring and diagnosis N89-14753
A maintenance and diagnostic information system N89-14754
IN-ATE: Fault diagnosis as expert system guided search N89-14757
On-board expert diagnostics for an avionics subsystem N89-14758
Distributed diagnostic performance reporting and analysis N89-14762
MEND: A self-improving diagnostic with deep knowledge N89-14764
Guidelines for preparation of diagnostic requirements N89-14765
GDS: An intelligent diagnostic software shell N89-14766
A generic architecture for knowledge-based equipment fault diagnosis N89-14767
Artificial intelligence in test program development N89-14769
Sensor-based diagnosis using knowledge of structure and function N89-14770

**DIAMONDS**
Experiments with three identical ultraprecision machine tools
[DE88-016324] N89-14445
Diamond chemical vapor deposition apparatus
[NASA-TT-20380] N89-14870

**DIELECTRICS**
Mechanical reliability of piezoelectric and dielectric ceramics
[AD-A198458] N89-14327
An advanced study of natural convection immersion cooling of a 3 x 3 array of simulated components in an enclosure filled with dielectric liquid
[AD-A197962] N89-14398

**DIFFERENCE EQUATIONS**
Universal limiter for transient interpolation modeling of the advective transport equations: The ULTIMATE conservative difference scheme
[NASA-TM-100916] N89-14794

**DIFFERENTIAL EQUATIONS**
A direct iterative-variational method for solving large sets of linear algebraic equations
[DE88-016149] N89-14780
Approximation methods for the consistent initialization of differential-algebraic equations
[DE88-017316] N89-14781
Computational methods and software for differential equations and their applications
[DE89-000025] N89-14783
Numerical schemes in the stabilization method for nonlinear differential equations of second order
[DE88-703773] N89-14789

**DIFFUSE RADIATION**
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
[AD-A198361] N89-14439

**DIFFUSION**
Parallel heterogeneous mesh refinement for advective-diffusive equations
[DE88-017026] N89-14786

**DIFFUSION COEFFICIENT**
Measurement and prediction of mass transfer in solid catalysts N89-14267
Durability of adhesive joints: An engineering study
[PB88-233473] N89-14307

**DIFFUSION FLAMES**
Aerodynamic and kinetic processes in flames
[AD-A198474] N89-14284
Modeling of hydrogen-air diffusion flame N89-14913

**DIGITAL FILTERS**
Frequency domain laser velocimeter signal processor
[NASA-CASE-LAR-13552-1-CU] N89-14385
Optical predetection processing for partially coherent systems N89-14815

**DIGITAL SIMULATION**
Description of the network method and the simulation package simulation based on networks (SIMONE)
[IWECO-5176814-87-1] N89-14730

**DIGITAL SYSTEMS**
Digital image analysis system for monitoring crack growth at elevated temperature
[AD-A198649] N89-14468
A survey of the state-of-the-art and focused research in range systems
[NASA-CR-184595] N89-14726
Optical predetection processing for partially coherent systems N89-14815

**DIGITAL TECHNIQUES**
Design of error control coding schemes for three problems of noisy information transmission, storage and processing
[B8811768] N89-14371
Precision of line following in digital images
[B8821610] N89-14486

**DIMENSIONAL MEASUREMENT**
Development of a microcircuit grid technique for automated crack length measurement for fatigue testing at elevated temperature
[AD-A198003] N89-14463

**DIMENSIONS**
Flux vector splitting of the one-dimensional Euler equations
[PB88-210109] N89-14214
Estimation of parameters and the goodness-of-fit test for multivariate distributions for data presented as one-dimensional histograms
[DE88-703697] N89-14803

**DIMERS**
Stability and photochemistry of ClO dimers formed at low temperature in the gas phase N89-14600
Chemistry of the CO dimer at low temperatures N89-14602

**DIODES**
Monolithic two-dimensional surface-emitting arrays of GaAs/AlGaAs diode lasers N89-14343
High-power AlGaAs channeled substrate planar diode lasers for spaceborne communications
[NASA-CR-4189] N89-14426
Semiconductor laser diodes and the design of a D.C. powered laser diode drive unit
[AD-A198556] N89-14441
Use of laser diodes for analog fiber optic diagnostics systems
[DE88-017012] N89-14833

**DIRECTIONAL SOLIDIFICATION (CRYSTALS)**
A viscoplastic constitutive model for anisotropic metals at high temperature N89-14305

**DISPLACEMENT MEASUREMENT**
Quantitative holographic interferometry: Measurement of solid object deformations
[ETN-89-93351] N89-14420

**DISPLAY DEVICES**
Development and use of interactive displays in real-time ground support research facilities
[NASA-TM-101694] N89-14683
Design and implementation of a supercomputer frame buffer system
[DE88-007834] N89-14703
Synthesis of graphical displays for tabular data
[AD-A198979] N89-14707
Polygons, stars, and clusters: An investigation of polygon displays
[AD-A198430] N89-14719
Computer modeling of polymers N89-14910
The USL NASA PC R and D interactive presentation development system
[NASA-CR-184539] N89-14979

**DISSOCIATION**
Reactions of metal ions and their clusters in the gas phase using laser ionization-Fourier transform mass spectrometry
[DE88-017281] N89-14431

**DISTANCE**
Antenna arrays with increasing according to arithmetical progression distances between the emitters
[AD-A198644] N89-14366

**DISTRIBUTED PROCESSING**
Analysis of FDDI synchronous traffic delays
[NASA-CR-183223] N89-14695
Fault-tolerant distributed algorithms for agreement and election
[AD-A198416] N89-14718
Evaluation of work distribution algorithms and hardware topologies in a multi-transputer network
[AD-A198530] N89-14736
Distributed diagnostic performance reporting and analysis N89-14762
Northeast Artificial Intelligence Consortium annual report 1986. Volume 3: Distributed artificial intelligence for communication network management
[AD-A197957] N89-14774
Resident database interfaces to the DAVID system, a heterogeneous distributed database management system
[NASA-CR-184615] N89-14946
USL NASA/RECON project presentations at the 1985 ACM Computer Science Conference: Abstracts and visuals
[NASA-CR-184522] N89-14962
The USL NASA PC R and D project: Detailed specifications of objects
[NASA-CR-184540] N89-14980

**DISTRIBUTION (PROPERTY)**
In situ observations of BrO over Antarctica: ER-2 aircraft results from 54 S to 72 S latitude N89-14583

**DISTRIBUTION FUNCTIONS**
Sunset over Brownistan
[AD-A198443] N89-14814

**DIURNAL VARIATIONS**
Observations of diurnal variations of BrO and OClO at McMurdo Station, Antarctica (78S) N89-14553

**DOCUMENT STORAGE**
An overview of selected information storage and retrieval issues in computerized document processing
[NASA-CR-184519] N89-14959

**DOMAINS**
An example of a harmonizable process whose spectral domain is not complete
[NASA-CR-184653] N89-14800
Knowledge based systems: A preliminary survey of selected issues and techniques
[NASA-CR-184513] N89-14953

**DOPPLER EFFECT**
Equipment to upgrade the facilities of the IIT (Illinois Institute of Technology) Fluid Dynamics Research Center
[AD-A198084] N89-14242
Cardiovascular system and space environment
[ETN-89-93600] N89-14674
Magnetic properties of C 4 Doppler shift patterns
[AD-A198602] N89-15062

**DOPPLER RADAR**
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899

**DOWNWASH**
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight
[NASA-CR-4212] N89-14821

**DRAG REDUCTION**
Passive venting technique for shallow cavities
[NASA-CASE-LAR-14031-1] N89-14232
Passive venting technique for shallow cavities
[NASA-CASE-LAR-13875-1] N89-14233

**DRAINAGE**
Application of inductively coupled plasma atomic emission spectroscopy analysis with a polychromator/monochromator combination the byproducts of coal-fired power stations
[PB88-226535] N89-14838

**DRIFT RATE**
Sunset over Brownistan
[AD-A198443] N89-14814
**DROPS (LIQUIDS)**
Analysis of transport mechanisms in dense fuel droplet sprays
[DE88-017256] N89-14393
Field tests and experiments on visibility modification
[AD-A197956] N89-14643
**DRUGS**
The effect of pyridostigmine bromine on inflight aircrew performance
[AD-A198828] N89-14670
**DUAL THRUST NOZZLES**
Experimental results for a two-dimensional supersonic inlet used as a thrust deflecting nozzle
[NASA-TM-83439] N89-14386
**DUMMIES**
Articulated total body model enhancements. Volume 1: Modifications
[AD-A198726] N89-14685
Articulated total body model enhancements. Volume 3: Programmer's guide
[AD-A197940] N89-14688
**DUST**
Investigation of the enhanced spatial density of submicron lunar ejecta between L values 1.2 and 3.0 in the earth's magnetosphere: Theory N89-15007
Debris-cloud collisions: Accretion studies in the Space Station N89-15033
**DYE LASERS**
The determination of energy transfer rates in the Ho:Tm:Cr:YAG laser material N89-14915
**DYNAMIC CHARACTERISTICS**
A general expression of Jacobian matrix and its simplified computation method: Relationships between the velocities of manipulator hand and joints
[DE88-754808] N89-14782
**DYNAMIC LOADS**
An investigation into fluid film lubrication in dynamically loaded bearings N89-14442
**DYNAMIC MODELS**
High-resolution dynamical modelling of the Antarctic stratospheric vortex N89-14594
Articulated total body model enhancements. Volume 1: Modifications
[AD-A198726] N89-14685
**DYNAMIC STRUCTURAL ANALYSIS**
Transonic aeroelastic analysis of launch vehicle configurations
[NASA-CR-4186] N89-14215
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
[NASA-CR-181724] N89-14896
Some test/analysis issues for the space station structural characterization experiment N89-14901
Equivalent linearization for fatigue life estimates of a nonlinear structure N89-14919
The influence of and the identification of nonlinearity in flexible structures N89-14932
**DYNAMICS EXPLORER SATELLITES**
Dynamics Explorer 1 SOI images of the Antarctic ozone hole N89-14515

## E

**EARPHONES**
Sound attenuation and speech transmission quality of five types of headsets
[IZF-1987-23] N89-14373
**EARTH ATMOSPHERE**
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
[AD-A198653] N89-14484
Mixing ratios of trace gases in the austral polar atmosphere during August and September of 1987 N89-14556
The effects of biomass burning on the concentration of trace gases in the atmosphere N89-14904
**EARTH CRUST**
NASA geodynamics program summary report, 1979-1987 progress and future outlook
[NASA-TM-4065] N89-14476
Heat flow and magnetization in the oceanic lithosphere
[NASA-CR-183346] N89-14653
**EARTH GRAVITATION**
On a solution of the Einstein gravitation equation for dust matter
[DE88-703739] N89-14893
**EARTH IONOSPHERE**
Impulse response of a frequency-dependent delay
[DE88-004793] N89-14368
**EARTH MAGNETOSPHERE**
Investigation of the enhanced spatial density of submicron lunar ejecta between L values 1.2 and 3.0 in the earth's magnetosphere: Theory N89-15007
A magnetospheric simulation at the Space Station N89-15024
**EARTH OBSERVATIONS (FROM SPACE)**
Homogeneous plate deformation as monitored by Satellite Laser Ranging (SLR) and analyzed using 3D affine transformation models
[B8821604] N89-14488
Polar Ozone Workshop. Abstracts
[NASA-CP-10014] N89-14503
Control of the flexible modes of an advanced technology geostationary platform N89-14902
**EARTH OBSERVING SYSTEM (EOS)**
Remote sensing information sciences research group
[NASA-CR-183374] N89-14481
**EARTH ORBITAL ENVIRONMENTS**
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
[NASA-TM-100459-VOL-1] N89-14331
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
[NASA-TM-100459-VOL-2] N89-14332
**EARTH ORBITS**
The effects of atomic oxygen on polymeric materials. N89-14921
**EARTH RADIATION BUDGET EXPERIMENT**
Summary of along-track data from the earth radiation budget satellite for several representative ocean regions
[NASA-RP-1206] N89-14634
**EARTH ROTATION**
Laser clocks and near field gravity of rotating objects N89-14911
**ECHO SOUNDING**
Ultrasonic depth gauge for liquids under high pressure
[NASA-CASE-LAR-13300-1-CU] N89-14407
**ECHOCARDIOGRAPHY**
Cardiovascular system and space environment
[ETN-89-93600] N89-14674
**ECOLOGY**
ELF (Extremely Low Frequency) communication system ecological monitoring program: Electromagnetic field measurements and engineering support, 1987
[AD-A198303] N89-14360
The influence of grazing on land surface climatological variables
[NASA-CR-183308] N89-14637
**ECONOMIC ANALYSIS**
Comparative study of career development and training programs N89-14927
**ECONOMICS**
Economic geology of lunar Helium-3 N89-14849
**ECOSYSTEMS**
ELF (Extremely Low Frequency) communication system ecological monitoring program: Electromagnetic field measurements and engineering support, 1987
[AD-A198303] N89-14360
**EDDY VISCOSITY**
An investigation of turbulence models N89-14905
**EDGES**
Small scale structure and mixing at the edge of the Antarctic vortex N89-14566
On the origin of steep edges and filaments in vorticity and potential vorticity fields N89-14593
Edge-plasmas and wall protection in RFPs (Reversed-Field Pinch)
[DE89-000386] N89-14860
**EDUCATION**
Living in space
[EP-222] N89-14684
Human factors in the Naval Air Systems Command: Computer based training
[DE88-015301] N89-14686
Curriculum in aerospace science and technology in cooperation with NASA Langley Research Center N89-14908
Transportable educational programs for scientific and technical professionals: More effective utilization of automated scientific and technical data base systems
[NASA-CR-184507] N89-14947
USL/DBMS NASA/RECON working paper series. Standards
[NASA-CR-184508] N89-14948
Overview of the NASA/RECON educational, research, and development activities of the Computer Science Departments of the University of Southwestern Louisiana and Southern University
[NASA-CR-184509] N89-14949
NASA RECON: Course development, administration, and evaluation. A research and development proposal
[NASA-CR-184510] N89-14950
Transportable, university-level educational programs in interactive information storage and retrieval systems
[NASA-CR-184511] N89-14951
A report on the USL NASA/RECON project. Part 1: The development of a transportable, university level, IS and R educational program
[NASA-CR-184515] N89-14955
An innovative, multidisciplinary educational program in interactive information storage and retrieval
[NASA-CR-184520] N89-14960
An innovative, multidisciplinary educational program in interactive information storage and retrieval. Presentation visuals
[NASA-CR-184521] N89-14961
General specifications for the development of a PC-based simulator of the NASA RECON system
[NASA-CR-184536] N89-14976
The USL NASA PC R and D interactive presentation development system
[NASA-CR-184539] N89-14979
**EIGENVALUES**
On the labeling and symmetry adaptation of the solvable finite groups representations
[DE88-703954] N89-14812
Generalized Eigenvalues for pairs on heritian matrices N89-14923
**EINSTEIN EQUATIONS**
On a solution of the Einstein gravitation equation for dust matter
[DE88-703739] N89-14893
**EJECTA**
Investigation of the enhanced spatial density of submicron lunar ejecta between L values 1.2 and 3.0 in the earth's magnetosphere: Theory N89-15007
**EJECTION**
Articulated total body model enhancements. Volume 1: Modifications
[AD-A198726] N89-14685
Articulated total body model enhancements. Volume 3: Programmer's guide
[AD-A197940] N89-14688
**ELASTIC DEFORMATION**
A unified model for predicting the stress and strain distributions around cracks of any length, including elastic, plastic, creep and cyclic deformation N89-14455
**ELASTOHYDRODYNAMICS**
The role of thermoelastic effects in the scuffing failure of rolling/sliding EHD contacts
[AD-A198475] N89-14447
**ELASTOMERS**
Synthesis of energetic single phase and multi-phase polymers
[AD-A198431] N89-14325
The synthesis and structure of polyphosphazenes
[AD-A198519] N89-14329
**ELECTRIC CHARGE**
Molecular spectroscopy using charge transfer device detectors
[AD-A198593] N89-14288
**ELECTRIC CONDUCTORS**
Electromagnetic penetration through finite-length narrow slots in planar conducting screens
[DE88-016046] N89-14370
**ELECTRIC CONTACTS**
The role of thermoelastic effects in the scuffing failure of rolling/sliding EHD contacts
[AD-A198475] N89-14447
Effects of electron irradiation on high temperature superconductors and contacts to high temperature superconductors N89-14900
**ELECTRIC CORONA**
Laser generated large amplitude longitudinal fields in inhomogeneous plasma with second harmonic super density resonances and quasi-uniform coronal oscillations N89-14840
**ELECTRIC CURRENT**
Current induced by HEMP (High-Altitude Electromagnetic Pulse) on wire above ground
[PB88-212048] N89-14353
Break junctions 1
[PB88-241849] N89-14869
**ELECTRIC FIELDS**
Magnetic and electric field meters developed for the US Department of Energy
[NASA-CR-184628] N89-14421
Laser generated large amplitude longitudinal fields in inhomogeneous plasma with second harmonic super density resonances and quasi-uniform coronal oscillations N89-14840
**ELECTRIC POTENTIAL**
Break junctions 1
[PB88-241849] N89-14869
**ELECTRIC POWER PLANTS**
Photovoltaics as an operating energy system
[DE88-017167] N89-14498
**ELECTRIC POWER SUPPLIES**
Photovoltaics as an operating energy system
[DE88-017167] N89-14498

**ELECTRIC PROPULSION**
ETX-I: First-generation single-shaft electric propulsion system program. Volume 2: Battery
|DE89-000079| N89-14378
**ELECTRIC WIRE**
Infrared temperature monitoring and control of final solder-joint temperature on flat flex cables
|DE89-000409| N89-14349
**ELECTRICAL ENGINEERING**
Center for Electronics and Electrical Engineering technical progress bulletin covering Center programs, October to December 1987 with 1988 CEEE events calendar
|PB88-232913| N89-14375
**ELECTRICAL MEASUREMENT**
Magnetic and electric field meters developed for the US Department of Energy
|NASA-CR-184628| N89-14421
**ELECTRICAL PROPERTIES**
Transient magnetohydrodynamic liquid-metal flows in a rectangular channel with a moving conducting wall
|AD-A197308| N89-14841
**ELECTRICAL RESISTIVITY**
Stability of bulk Ba2YCu3O(7-x) in a variety of environments
|NASA-TM-101401| N89-14310
RF surface resistance of YBa2Cu3O(7-x) thin films N89-14347
Measurement precautions for high-resistivity silicon solar cells
|DE89-000438| N89-14499
Electrical conductivity of carbonaceous chondrites and electric heating of meteorite parent bodies N89-15011
Electrical conductivity of chondritic meteorites N89-15012
**ELECTRO-OPTICS**
Molecular spectroscopy using charge transfer device detectors
|AD-A198593| N89-14288
High-power AlGaAs channeled substrate planar diode lasers for spaceborne communications
|NASA-CR-4189| N89-14426
Integrated acoustooptic device modules for optical information processing
|AD-A198061| N89-14835
Semiconducting transition metal silicides: New materials for optoelectronics on silicon
|AD-A198139| N89-14881
**ELECTROCHEMICAL CELLS**
The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
**ELECTROCHEMICAL OXIDATION**
Electrochemical studies of molten glass N89-14266
**ELECTROCHEMISTRY**
Electrochemical synthesis of barium cuprate
|NASA-TT-20327| N89-14271
**ELECTRODEPOSITION**
Composite ceramic superconducting filaments for superconducting cable
|AD-A198657| N89-14888
**ELECTRODES**
The surface enhanced raman scattering of the protonated forms of DABCO at a silver electrode
|AD-A197930| N89-14278
Monochromatic imaging studies of a low pressure arc burning on molten Inconel 718 alloy electrodes during vacuum arc remelting
|DE88-012855| N89-14292
**ELECTROENCEPHALOGRAPHY**
Perceptual factors in workload: A neuromagnetic study
|AD-A198487| N89-14681
**ELECTROKINETICS**
Analysis of electrophoresis performance
|NASA-CR-183508| N89-14265
**ELECTROMAGNETIC ABSORPTION**
A new method for trace metal determinations by monitoring modulated magnetically induced optical rotation in atomic vapours
|AD-A198799| N89-14272
Preparation, structure, and spectroscopic properties of nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 crystals
|AD-A198476| N89-14883
**ELECTROMAGNETIC FIELDS**
Electromagnetic time-domain calculations in two and three dimensions
|DE89-000311| N89-14355
ELF (Extremely Low Frequency) communication system ecological monitoring program: Electromagnetic field measurements and engineering support, 1987
|AD-A198303| N89-14360
Electromagnetic penetration through finite-length narrow slots in planar conducting screens
|DE88-016046| N89-14370
**ELECTROMAGNETIC INTERFERENCE**
Method and apparatus for reducing speckle
|NASA-CASE-LAR-13771-1| N89-14428
**ELECTROMAGNETIC MEASUREMENT**
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
|AD-A198656| N89-14367
**ELECTROMAGNETIC NOISE**
Description of the RSG-10 noise data base --- speech recognition/communication
|IZF-1988-03| N89-14945
**ELECTROMAGNETIC PULSES**
Current induced by HEMP (High-Altitude Electromagnetic Pulse) on wire above ground
|PB88-212048| N89-14353
Impulse response of a frequency-dependent delay
|DE88-004793| N89-14368
**ELECTROMAGNETIC RADIATION**
ELF (Extremely Low Frequency) communication system ecological monitoring program: Electromagnetic field measurements and engineering support, 1987
|AD-A198303| N89-14360
Light weight high performance manipulators
|AD-A198647| N89-14448
**ELECTROMAGNETIC SCATTERING**
Numerical methods to solve the problem of scattering from electrically large bodies
|AD-A198098| N89-14359
Finite element electromagnetic scattering: An interactive micro-computer algorithm
|AD-A198552| N89-14364
**ELECTROMAGNETIC WAVE TRANSMISSION**
Optical and infrared properties of the marine atmosphere, phase 1
|FEL-1987-76| N89-14630
**ELECTROMAGNETS**
Electromagnetic penetration through finite-length narrow slots in planar conducting screens
|DE88-016046| N89-14370
**ELECTRON ACCELERATION**
Electron acceleration by laser fields in a gas
|DE89-000567| N89-14433
**ELECTRON BEAMS**
Electron-beam-pumped semiconductor lasers N89-14425
**ELECTRON IRRADIATION**
Effects of electron irradiation on high temperature superconductors and contacts to high temperature superconductors N89-14900
**ELECTRON SCATTERING**
Green's function Monte Carlo calculations of 4He
|DE89-000379| N89-14802
**ELECTRONIC EQUIPMENT**
An advanced study of natural convection immersion cooling of a 3 x 3 array of simulated components in an enclosure filled with dielectric liquid
|AD-A197962| N89-14398
The JNC-16: A 16-channel data acquisition and analysis module
|DE88-017200| N89-14699
The FIS electronics troubleshooting system N89-14742
LARCMACS: A TEX macro set for typesetting NASA reports
|NASA-TM-101522| N89-14994
**ELECTRONIC EQUIPMENT TESTS**
The B-1B central integrated test system expert parameter system N89-14763
**ELECTRONS**
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
|AD-A198361| N89-14439
**ELECTROSTATICS**
Electrostatic aggregation of finely-comminuted geological materials N89-15027
**ELEMENTARY PARTICLES**
Research Program in Elementary Particle Theory
|DE88-017241| N89-14891
**ELLIPTIC DIFFERENTIAL EQUATIONS**
Numerical grid generation and potential airfoil analysis and design
|AD-A197972| N89-14219
**ELLIPTIC FUNCTIONS**
Connected part of the covariant Tate p-divisible group and the zeta-function of the family of hyperelliptic curves y sup 2 = 1 + mu(chi sup N) modulo various primes
|PB86-226659| N89-14777
**EMERGENCY LOCATOR TRANSMITTERS**
Legislated emergency locating transmitters and emergency position indicating radio beacons
|NASA-CASE-GSC-12892-1| N89-14374
**EMISSION**
Fiber-optic spectrochemical emission sensors
|DE88-017175| N89-14275
**EMISSION SPECTRA**
The future of intelligent spectrometers in metal speciation by atomic emission spectrometry
|AD-A198592| N89-14287
The effect of torch pressure on analyte response in a 27 MHz inductively coupled plasma
|AD-A198595| N89-14863
**EMITTERS**
Antenna arrays with increasing according to arithmetical progression distances between the emitters
|AD-A198644| N89-14366
**EMOTIONAL FACTORS**
Influence of emotional-pain stress on contractile function of myocardium during long-term hypokinesia N89-14662
**ENDOSCOPES**
Development of an endoscopic probe for radial metrology
|NASA-CR-184577| N89-14417
**ENERGY CONVERSION**
Introduction of the Proceedings of the Tenth Symposium on Biotechnology for Fuels and Chemicals
|DE88-016361| N89-14667
**ENERGY DISSIPATION**
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
|AD-A198361| N89-14439
Energy dissipation of monochromatic sea waves in the turbulent boundary layer
|KNMI-TR-104| N89-14657
**ENERGY GAPS (SOLID STATE)**
Break junctions 1
|PB88-241849| N89-14869
**ENERGY LEVELS**
The determination of energy transfer rates in the Ho:Tm:Cr:YAG laser material N89-14915
**ENERGY TECHNOLOGY**
Starpower: The US and the international quest for fusion energy, contractor documents
|PB88-214663| N89-14839
Research and technology utilization
|DE88-016749| N89-14996
**ENERGY TRANSFER**
Use of operational analyses to study the dynamics of troposphere-stratosphere interactions in polar regions N89-14597
Spectroscopic investigation of the Cr to Tm energy transfer in Yttrium Aluminum Garnet (YAG) crystals N89-14903
The determination of energy transfer rates in the Ho:Tm:Cr:YAG laser material N89-14915
**ENGINE DESIGN**
Materials and structures for hypersonic vehicles
|NASA-TM-101501| N89-14264
Parametric studies of advanced turboprops
|NASA-TM-101389| N89-14465
A review of failure models for unidirectional ceramic matrix composites under monotonic loads
|NASA-TM-101421| N89-14470
**ENGINE PARTS**
A review of failure models for unidirectional ceramic matrix composites under monotonic loads
|NASA-TM-101421| N89-14470
**ENGINE TESTS**
Thrust-reverser flow investigation on a twin-engine transport
|NASA-TP-2856| N89-14213
Fire extinguishing agent evaluation in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS)
|AD-A198523| N89-14227
**ENGINEERING MANAGEMENT**
Transportable educational programs for scientific and technical professionals: More effective utilization of automated scientific and technical data base systems
|NASA-CR-184507| N89-14947
NASA RECON: Course development, administration, and evaluation. A research and development proposal
|NASA-CR-184510| N89-14950
Transportable, university-level educational programs in interactive information storage and retrieval systems
|NASA-CR-184511| N89-14951
A report on the USL NASA/RECON project. Part 1: The development of a transportable, university level, IS and R educational program
|NASA-CR-184515| N89-14955
**ENGLISH LANGUAGE**
The language distribution of bibliographic records in selected online databases N89-14940
**ENTRAINMENT**
Underexpanded noncondensing turbulent gas jets in liquids
|AD-A197939| N89-14396
Sediment-transport experiments in zero-gravity N89-15020
The initiation of grain movement by wind N89-15029

**ENVIRONMENT EFFECTS**
Detailed design specification for a prototype Assessment System for Aircraft Noise (ASAN)
| AD-A197936 | N89-14818
**ENVIRONMENT MODELS**
A microcomputer pollution model for civilian airports and air force bases, model description
| AD-A199003 | N89-14616
**ENVIRONMENT POLLUTION**
Statistical model of environmental contaminants using variance spectrum analysis
| PB88-235130 | N89-14615
**ENVIRONMENT SIMULATORS**
Articulated total body model enhancements. Volume 3: Programmer's guide
| AD-A197940 | N89-14688
**ENVIRONMENTAL LABORATORIES**
Touchstone for success: The Materials and Process Laboratories
| ESA-BR-52 | N89-14244
**ENVIRONMENTAL MONITORING**
ELF (Extremely Low Frequency) communication system ecological monitoring program: Electromagnetic field measurements and engineering support, 1987
| AD-A198303 | N89-14360
DOE/DOD environmental data bank
| DE88-015262 | N89-14942
**ENVIRONMENTAL SURVEYS**
ELF (Extremely Low Frequency) communication system ecological monitoring program: Electromagnetic field measurements and engineering support, 1987
| AD-A198303 | N89-14360
Aircraft emissions characterization
| AD-A197864 | N89-14617
**ENVIRONMENTS**
A study of environmental influences on the structure of spiral galaxy disks N89-15051
**EPOXY RESINS**
The effects of atomic oxygen on polymeric materials N89-14921
**EQUATIONS OF MOTION**
Dynamics of structures: Solution techniques
| DE88-017022 | N89-14461
Dynamics of structures: Fundamentals
| DE88-017027 | N89-14462
The initiation of grain movement by wind N89-15029
Aeolian processes aboard a Space Station: Saltation and particle trajectory analysis N89-15039
**EQUILIBRIUM**
Solid phase equilibria in the Pt-Ga-As and Pt-Ga-Sb systems
| AD-A198654 | N89-14887
**EQUIPMENT SPECIFICATIONS**
Multicolor pyrometer for materials processing in space, phase 2
| NASA-CR-183358 | N89-14406
Phase transformation and enhanced nuclear resonance in acoustics N89-14816
Diamond chemical vapor deposition apparatus
| NASA-TT-20380 | N89-14870
Impact cratering in reduced-gravity environments: Early experiments on the NASA KC-135 aircraft N89-15008
**EROSION**
The effects of atomic oxygen on polymeric materials N89-14921
**ERROR ANALYSIS**
Geolocation via satellite: A methodology and error analysis
| AD-A197955 | N89-14253
A study for systematic errors of the GLA forecast model in tropical regions
| NASA-TM-101194 | N89-14651
Random access algorithms for multiuser computer communication networks
| AD-A198090 | N89-14713
IN-ATE: Fault diagnosis as expert system guided search N89-14757
A generic architecture for knowledge-based equipment fault diagnosis N89-14767
**ERROR CORRECTING CODES**
Design of error control coding schemes for three problems of noisy information transmission, storage and processing
| B881176B | N89-14371
A concatenated coded modulation scheme for error control (addition 2)
| NASA-CR-183260 | N89-14706
**ERRORS**
Possible measurement errors in calibrated AVHRR (Advanced Very High Resolution Radiometer) data
| AD-A198342 | N89-14414
Simulation and analysis of a Geopotential Research Mission N89-14478
Random access algorithms for multiuser computer communication networks
| AD-A198090 | N89-14713
**ESA SATELLITES**
ESA's activities report
| ISSN-0258-025X | N89-14937
**ESTIMATES**
A survey of the state-of-the-art and focused research in range systems
| NASA-CR-184595 | N89-14726
Estimation of parameters and the goodness-of-fit test for multivariate distributions for data presented as one-dimensional histograms
| DE88-703697 | N89-14803
A note on extended quasi-likelihood
| AD-A198042 | N89-14805
Equivalent linearization for fatigue life estimates of a nonlinear structure N89-14919
**ETCHING**
Modeling of RF plasmas in a parallel plate etch reactor
| B8811775 | N89-14865
**ETHYLENE**
Anelastic and thermal properties of ethylene/acrylic acid copolymers partially ionized with transition metals
| DE88-017006 | N89-14316
**EULER EQUATIONS OF MOTION**
Flux vector splitting of the one-dimensional Euler equations
| PB88-210109 | N89-14214
Numerical analysis of flow through oscillating cascade sections
| NASA-TM-101417 | N89-14220
**EUROPEAN SPACE AGENCY**
Touchstone for success: The Materials and Process Laboratories
| ESA-BR-52 | N89-14244
ESA's activities report
| ISSN-0258-025X | N89-14937
**EUROPEAN SPACE PROGRAMS**
Transfer airlock requirements
| TAL-RP-SN-003 | N89-14254
ESA's activities report
| ISSN-0258-025X | N89-14937
**EUTECTIC COMPOSITES**
Transport and junction physics of semiconductor-metal eutectic composites
| AD-A198480 | N89-14884
**EVALUATION**
Development of strain gage evaluation channels
| DE88-017350 | N89-14412
Evaluation of the pseudo pilot effect on baseline controller study data N89-14920
An hierarchical approach to performance evaluation of expert systems
| NASA-CR-184527 | N89-14967
A performance evaluation of the IBM 370/XT personal computer
| NASA-CR-184542 | N89-14982
A programming environment evaluation methodology for object-oriented systems
| NASA-CR-184552 | N89-14992
**EVAPORATION**
Analysis of transport mechanisms in dense fuel droplet sprays
| DE88-017256 | N89-14393
Use of time-resolved techniques for studying shock-induced vaporization
| DE88-017168 | N89-14395
Remote sensing technologies and spatial data applications
| AD-A195809 | N89-14480
Transient heat transfer from shrinking LOX-drop N89-14916
**EVAPORATIVE COOLING**
Capillary heat transport and fluid management device
| NASA-CASE-MFS-28217-1 | N89-14392
**EVOLUTION**
The evolution of AAOE observed constituents with the polar vortex N89-14568
**EVOLUTION (DEVELOPMENT)**
Experimental constraints on the origin of chondrules N89-15043
**EXCIMER LASERS**
Transient behaviors in chemical reactions: Nanosecond infrared spectroscopy, chemically pumped visible and near-IR lasers
| AD-A198484 | N89-14286
Subpicosecond, high-brightness excimer laser systems
| DE88-016239 | N89-14430
**EXCITATION**
Effects of core turbulence on jet excitability
| NASA-TM-101405 | N89-14403
**EXERCISE PHYSIOLOGY**
Influence of high temperature on total gas metabolism of animals with limitation of motor activity N89-14661
Functional significance and mechanisms of variability in baroreceptor reflex N89-14664
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
| AD-A197472 | N89-14668
**EXHAUST EMISSION**
Aircraft emissions characterization
| AD-A197864 | N89-14617
**EXOBIOLOGY**
Aerospace medicine and biology: A continuing bibliography with indexes
| NASA-SP-7011(316) | N89-14675
Exobiology experiment concepts for Space Station N89-15017
**EXPERIMENT DESIGN**
Planetary impact experimentation N89-14999
A planetary ultra hypervelocity impact mechanics and shock wave science facility N89-15005
Proposed earth-based cratering experiments at low g in hard vacuum N89-15006
Volatilization-devolatilization reactions N89-15014
Exobiology experiment concepts for Space Station N89-15017
Cautionary tales for reduced-gravity particle research N89-15026
Low-gravity facilities for Space Station planetology experiments N89-15032
**EXPERT SYSTEMS**
A preliminary report on developing an expert system for computer-aided formulation of propellants
| AD-A198088 | N89-14339
Remote sensing information sciences research group
| NASA-CR-183374 | N89-14481
The NC (Numerically Controlled) assistant: Interfacing knowledge based manufacturing tools to CAO/CAM systems
| DE88-016742 | N89-14709
Exploration in the field of expert systems. Report on the project Expert 01
| AD-1987-1271 | N89-14729
Incorporating design for test into an IC design expert system N89-14746
The integrated diagnostic model: Towards a second generation diagnostic expert system N89-14747
Expert Missile Maintenance Aid (EMMA): An application of artificial intelligence technology to the munition maintenance domain N89-14748
A generic expert diagnostician N89-14750
A flight expert system (FLES) for on-board fault monitoring and diagnosis N89-14753
A maintenance and diagnostic information system N89-14754
Expert systems to give installation advice for UNIX 4.2BSD and to help connect a terminal to a computer N89-14755
Expert system rules from CAD databases N89-14756
IN-ATE: Fault diagnosis as expert system guided search N89-14757
On-board expert diagnostics for an avionics subsystem N89-14758
Beyond rules: The next generation of expert systems N89-14759
Expert systems in higher echelon maintenance activities N89-14761
The B-1B central integrated test system expert parameter system N89-14763
MEND: A self-improving diagnostic with deep knowledge N89-14764
Expert system on a chip: An engine for real-time approximate reasoning N89-14771
An evaluation of five PC-based expert system shells
| AD-A197915 | N89-14773
USL/DBMS NASA/RECON working paper series. Standards
| NASA-CR-184508 | N89-14948
Knowledge based systems: A preliminary survey of selected issues and techniques
| NASA-CR-184513 | N89-14953
Knowledge based systems: A critical survey of major concepts, issues, and techniques
| NASA-CR-184517 | N89-14957
An hierarchical approach to performance evaluation of expert systems
| NASA-CR-184527 | N89-14967
**EXPLODING WIRES**
High-Speed Microphotographic Laboratory
| DE88-017009 | N89-14411
**EXPLOSIONS**
High-Speed Microphotographic Laboratory
| DE88-017009 | N89-14411
**EXPLOSIVES**
The synthesis of carborane-oxetane monomers and their polymerization
| AD-A198596 | N89-14330
**EXPONENTIAL FUNCTIONS**
Sunset over Brownistan
| AD-A198443 | N89-14814

**EXPOSURE**
Adsorption of chlorine on clean and on oxygen pre-exposed Al(3)
[AD-A198005] N89-14280
**EXTINCTION**
Extinction and backscatter measurements of Antarctic PSC's, 1987: Implications for particle and vapor removal N89-14532
**EXTRAGALACTIC RADIO SOURCES**
Studies of the interstellar medium in the inner galaxy at 21 centimeters N89-15055
**EXTREME ULTRAVIOLET RADIATION**
Study of extreme ultraviolet laser sources for the guiding of particle beams
[DE88-008918] N89-14435
**EXTREMELY LOW FREQUENCIES**
ELF (Extremely Low Frequency) communication system ecological monitoring program: Electromagnetic field measurements and engineering support, 1987
[AD-A198303] N89-14360
**EYE MOVEMENTS**
Eye and head motion during head turns in spaceflight
[NASA-TM-100466] N89-14676

## F

**F-16 AIRCRAFT**
Investigation of a moving-model technique for measuring ground effect
[NASA-TM-4080] N89-14217
The poststall nonlinear dynamics and control of an F-18: A preliminary investigation N89-14922
**FABRICATION**
Fabrication and testing of lightweight hydraulic system simulator hardware. Phase 2: Addendum
[AD-A198524] N89-14243
Ceramics: Materials for severe environments
[PB88-240049] N89-14308
**FABRICS**
Statistical characterization of carbon phenolic prepreg materials, volume 1
[NASA-CR-179416] N89-14306
**FACE (ANATOMY)**
The use of short range stereophotogrammetry for facial asymmetry and growth studies; analysis and model
[B8821611] N89-14491
**FAILURE**
The nature of the aircraft component failure process: A working note
[AD-A197979] N89-14234
Study of high temperature failure mechanisms in ceramics
[AD-A198375] N89-14324
The role of thermoelastic effects in the scuffing failure of rolling/sliding EHD contacts
[AD-A198475] N89-14447
**FAILURE ANALYSIS**
Reasoning about multiple faults N89-14743
A flight expert system (FLES) for on-board fault monitoring and diagnosis N89-14753
Cautionary tales for reduced-gravity particle research N89-15026
**FAILURE MODES**
Method of insetting predesigned disbond areas into composite laminates
[NASA-CASE-LAR-13225-1] N89-14258
A review of failure models for unidirectional ceramic matrix composites under monotonic loads
[NASA-TM-101421] N89-14470
**FALLING**
Falling antimatter: An experiment to measure the gravitational acceleration of the antiproton
[DE89-000313] N89-14892
**FALSE ALARMS**
Automatic detection, tracking and sensor integration
[AD-A198347] N89-14361
**FAR INFRARED RADIATION**
The nature of luminous IRAS galaxies N89-15053
CO and IRAS FIR emission in interacting galaxies N89-15058
**FATIGUE (MATERIALS)**
Cyclic deformation, damage, and effects of environment in the Ni3Al ordered alloy at elevated temperatures
[AD-A198500] N89-14300
The influence of porosity on short fatigue crack growth at large strain amplitudes
[AD-A198477] N89-14464
**FATIGUE LIFE**
Development of a microcircuit grid technique for automated crack length measurement for fatigue testing at elevated temperature
[AD-A198003] N89-14463
Equivalent linearization for fatigue life estimates of a nonlinear structure N89-14919
**FATIGUE TESTS**
Automated fatigue crack growth measurement
[AD-A198642] N89-14466
Fatigue evolution of small two and three dimensional cracks under variable and constant amplitude loading
[MM-AL/AP-04-88] N89-14471
**FAULT TOLERANCE**
Design of fault-tolerant circuits for photovoltaic concentrators
[DE89-001062] N89-14379
Fault-tolerant distributed algorithms for agreement and election
[AD-A198416] N89-14718
**FAULT TREES**
Avionics fault tree analysis and artificial intelligence for future aircraft maintenance N89-14760
**FEAR**
An inquiry into panic and its differentiation from other types of anxiety N89-14679
**FEASIBILITY ANALYSIS**
Feasibility study for the development of a joint surge and wave model
[PB88-230917] N89-14652
Composite ceramic superconducting filaments for superconducting cable
[AD-A198657] N89-14888
**FEEDBACK**
Random access algorithms for multiuser computer communication networks
[AD-A198090] N89-14713
**FEEDBACK CONTROL**
Design of feedback control systems for unstable plants with saturating actuators
[NASA-CR-183392] N89-14377
The poststall nonlinear dynamics and control of an F-18: A preliminary investigation N89-14922
**FEMUR**
Effects of calcitonin and retabolil on rat femur in hypokinesia N89-14659
**FERRIC IONS**
Reactions of metal ions and their clusters in the gas phase using laser ionization-Fourier transform mass spectrometry
[DE88-017281] N89-14431
**FIBER COMPOSITES**
Data acquisition and control for multiple composite life tests
[AD-A198395] N89-14263
Temperature effect on stress concentration around circular hole in a composite material specimen representative of X-29A forward-swept wing aircraft
[NASA-CR-179439] N89-14456
**FIBER OPTICS**
Determination of pH by flow injection analysis and by fiber optrode analysis
[PB88-235502] N89-14270
Fiber-optic spectrochemical emission sensors
[DE88-017175] N89-14275
Combining signals of widely differing bit rates on fiber optic subscriber lines
[PB88-210067] N89-14352
Spacelab system analysis: A study of the Marshall Avionics System Testbed (MAST)
[NASA-CR-183516] N89-14354
Optical fiber data transfer system
[NASA-CR-181704] N89-14376
Analysis of FDDI synchronous traffic delays
[NASA-CR-183223] N89-14695
Use of laser diodes for analog fiber optic diagnostics systems
[DE88-017012] N89-14833
**FIBERS**
Graphite fluoride fiber polymer composite material
[NASA-CASE-LEW-14472-1] N89-14259
Composite ceramic superconducting filaments for superconducting cable
[AD-A198657] N89-14888
The effects of atomic oxygen on polymeric materials N89-14921
**FIELD EFFECT TRANSISTORS**
New MBE buffer for micron- and quarter-micron-gateGaAs MESFETs N89-14346
**FILLERS**
Statistical characterization of carbon phenolic prepreg materials, volume 1
[NASA-CR-179416] N89-14306
**FINITE DIFFERENCE THEORY**
Coupled three-dimensional conduction and natural convection heat transfer N89-14388
A finite difference analysis of the heat transfer in periodic cavity flows N89-14389
Development of the general interpolants method for the CYBER 200 series of supercomputers
[NASA-CR-4183] N89-14704
Finite-difference methods for solution of the many-dimensional nonlinear Schroedinger equation
[DE88-703772] N89-14788
Modifying PASVART to solve singular nonlinear 2-point boundary problems N89-14906
Modeling of transitional flows N89-14917
**FINITE ELEMENT METHOD**
Finite element electromagnetic scattering: An interactive micro-computer algorithm
[AD-A198552] N89-14364
Improvement in finite element meshes: Heat transfer in an infinite cylinder
[NASA-TM-101410] N89-14450
Dynamics of structures: Solution techniques
[DE88-017022] N89-14461
Parametric studies of advanced turboprops
[NASA-TM-101389] N89-14465
Finite element formulation for nonlinear viscoplastic material using a Q-model
[PB88-213764] N89-14776
Computational methods and software for differential equations and their applications
[DE89-000025] N89-14783
Determining conductivity by boundary measurements: Some numerical results
[AD-A198014] N89-14792
On the use of 1-D finite elements for the temperature behavior of a contoured and partially plated SC-Cut resonator
[AD-A198309] N89-14882
**FIRE EXTINGUISHERS**
Fire extinguishing agent evaluation in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS)
[AD-A198523] N89-14227
**FIREFLIES**
Firefly luciferase-structure and function
[AD-A198292] N89-14283
**FIRES**
Fire extinguishing agent evaluation in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS)
[AD-A198523] N89-14227
**FLAME PROPAGATION**
Aerodynamic and kinetic processes in flames
[AD-A198474] N89-14284
**FLAMES**
Dynamic combustion studies using advanced optical diagnostics. Volume 2: Tabulated data
[AD-A198025] N89-14281
**FLASHOVER**
Surface flashover threshold and switched fields of photoconductive semiconductor switches
[DE88-011618] N89-14876
**FLEXIBILITY**
Rheological studies on blends of rodlike and flexible chain polymers
[AD-A198455] N89-14326
Tooth contact shift in loaded spiral bevel gears o, IL, 25-27 Apr. 1989; sposored by ASME
[NASA-TM-101438] N89-14453
**FLEXIBLE BODIES**
The influence of and the identification of nonlinearity in flexible structures N89-14932
**FLIGHT CONTROL**
Comparison of the general dynamics ground clobber, algorithm with the GCAS and laws algorithms
[AD-A198479] N89-14226
Fabrication and testing of lightweight hydraulic system simulator hardware. Phase 2: Addendum
[AD-A198524] N89-14243
Aeroassisted orbital transfer vehicle control technology
[NASA-CR-179424] N89-14250
Reconfigurable flight control: An opportunity for integrated diagnostics N89-14744
**FLIGHT CREWS**
The effect of pyridostigmine bromine on inflight aircrew performance
[AD-A198828] N89-14670
Further investigation of contrast sensitivity and visual acuity in pilot detection of aircraft
[AD-A198434] N89-14680
**FLIGHT ENVELOPES**
Comparison of the general dynamics ground clobber algorithm with the GCAS and laws algorithms
[AD-A198479] N89-14226
**FLIGHT OPTIMIZATION**
A unified approach to vehicle design, control, and flight path optimization N89-14231
**FLIGHT PATHS**
A unified approach to vehicle design, control, and flight path optimization N89-14231
**FLIGHT TESTS**
Engines for Mini-RPV XM-1A
[AD-A198336] N89-14236
High speed data acquisition systems
[AD-A198194] N89-14735

A flight test design for studying airborne applications of air to ground duplex data link communications
N89-14924

**FLOODS**
Remote sensing technologies and spatial data applications
[AD-A195809] N89-14480

**FLOW DISTRIBUTION**
Two-equation low-Reynolds-number turbulence modeling of transitional boundary layer flows characteristic of gas turbine blades N89-14218
Turbofan forced mixer lobe flow modeling. 1: Experimental and analytical assessment
[NASA-CR-4147-PT-1] N89-14221
Dynamic stall computations using a zonal Navier-Stokes model
[AD-A197942] N89-14397
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet
[AD-A198360] N89-14399
A numerical simulation of the flow field and heat transfer in a rectangular passage with a turbulence promoter
[AD-A198579] N89-14400
Navier-Stokes calculations of transonic flows past cavities
[NASA-CR-4210] N89-14401
Overlapping grids for flow field calculations
N89-14918

**FLOW EQUATIONS**
Transient magnetohydrodynamic liquid-metal flows in a rectangular channel with a moving conducting wall
[AD-A197308] N89-14841

**FLOW VELOCITY**
The role of thermoelastic effects in the scuffing failure of rolling/sliding EHD contacts
[AD-A198475] N89-14447
Ozone profile measurements at McMurdo Station Antarctica during the spring of 1987 N89-14514

**FLUID DYNAMICS**
Equipment to upgrade the facilities of the IIT (Illinois Institute of Technology) Fluid Dynamics Research Center
[AD-A198084] N89-14242
Identification of dynamic parameters of a squeeze-film bearing N89-14443
On the origin of steep edges and filaments in vorticity and potential vorticity fields N89-14593
Proposed earth-based cratering experiments at low g in hard vacuum N89-15006

**FLUID FILMS**
An investigation into fluid film lubrication in dynamically loaded bearings N89-14442
The role of thermoelastic effects in the scuffing failure of rolling/sliding EHD contacts
[AD-A198475] N89-14447

**FLUID FLOW**
Liquid sheet radiator apparatus
[NASA-CASE-LEW-14295-1] N89-14348
Analysis of transport mechanisms in dense fuel droplet sprays
[DE88-017256] N89-14393
Pressure measuring probe
[NASA-CASE-LAR-13853-1] N89-14423
Polar vortex dynamics N89-14588
Design and calibration of the carousel wind tunnel
N89-15021

**FLUID INJECTION**
Determination of pH by flow injection analysis and by fiber optrode analysis
[PB88-235502] N89-14270

**FLUID MANAGEMENT**
Capillary heat transport and fluid management device
[NASA-CASE-MFS-28217-1] N89-14392

**FLUID MECHANICS**
Parallel heterogeneous mesh refinement for advective-diffusive equations
[DE88-017026] N89-14786

**FLUORIDES**
Graphite fluoride fiber polymer composite material
[NASA-CASE-LEW-14472-1] N89-14259

**FLUOROPOLYMERS**
Synthesis of energetic single phase and multi-phase polymers
[AD-A198431] N89-14325

**FLUX (RATE)**
Comparison of charge transfer device and photomultiplier tube performance for extremely low photon fluxes
[AD-A198594] N89-14382

**FLUX VECTOR SPLITTING**
Flux vector splitting of the one-dimensional Euler equations
[PB88-210109] N89-14214

**FLY ASH**
Application of inductively coupled plasma atomic emission spectroscopy analysis with a polychromator/monochromator combination the byproducts of coal-fired power stations
[PB88-226535] N89-14838

**FOAMS**
Composite foams
[DE89-000368] N89-14315

**FOG**
Field tests and experiments on visibility modification
[AD-A197956] N89-14643

**FOG DISPERSAL**
Field tests and experiments on visibility modification
[AD-A197956] N89-14643

**FOILS (MATERIALS)**
High-Speed Microphotographic Laboratory
[DE88-017009] N89-14411

**FORECASTING**
Remote sensing technologies and spatial data applications
[AD-A195809] N89-14480
Base rate effects on the interpretation of probability and frequency expressions
[AD-A198456] N89-14808

**FORESTS**
The influence of grazing on land surface climatological variables
[NASA-CR-183308] N89-14637

**FORMALDEHYDE**
Composite foams
[DE89-000368] N89-14315

**FORMAT**
VAMAS surface chemical analysis standard data transfer format with skeleton decoding programs
[NPL-DMA(A)-164] N89-14724

**FORTRAN**
ELEFUNT test results under FORTRAN-PLUS on the active memory technology DAP 510-8
[DE88-017264] N89-14700

**FOSSIL FUELS**
Introduction of the Proceedings of the Tenth Symposium on Biotechnology for Fuels and Chemicals
[DE88-016361] N89-14667

**FOUNDRIES**
Improved foundry castings utilizing CAD/CAM (Computer Aided Design/Computer Aided Manufacture). Volume 1: Overview
[AD-A198067] N89-14712

**FOURIER TRANSFORMATION**
Reactions of metal ions and their clusters in the gas phase using laser ionization-Fourier transform mass spectrometry
[DE88-017281] N89-14431

**FRACTIONATION**
Volatilization-fractionation of silicates related to chondrite composition N89-15036

**FRACTURE MECHANICS**
Mechanical property enhancement in ceramic matrix composites
[PB88-232863] N89-14257
Fracture behaviour under impact 2
[AD-A198643] N89-14467

**FRACTURE STRENGTH**
Analysis of ductile-brittle transition temperatures for controlled-rolled, microalloyed, C-Mn-based steels
[AD-A198132] N89-14298
Mechanical reliability of piezoelectric and dielectric ceramics
[AD-A198458] N89-14327
Semi-interpenetrating polymer network's of polyimides: Fracture toughness N89-14912

**FREE ELECTRON LASERS**
Chemical and Laser Sciences Division
[DE88-017140] N89-14274
The electron laser facility: A millimeter wave free-electron laser amplifier
[DE88-016118] N89-14436
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
[AD-A198361] N89-14439

**FREE FLOW**
Thrust-reverser flow investigation on a twin-engine transport
[NASA-TP-2856] N89-14213

**FREE RADICALS**
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product
N89-14601

**FREEZING**
Modelling the Antarctic ozone hole N89-14605

**FREQUENCIES**
Base rate effects on the interpretation of probability and frequency expressions
[AD-A198456] N89-14808

**FREQUENCY MEASUREMENT**
Frequency domain laser velocimeter signal processor
[NASA-CASE-LAR-13552-1-CU] N89-14385

**FRICTION FACTOR**
Dynamical adjustments in the planetary boundary layer N89-14618

**FUEL CELLS**
Advanced concepts for contaminant resistant fuel cells
[DE88-017151] N89-14496

**FUEL COMBUSTION**
Analysis of transport mechanisms in dense fuel droplet sprays
[DE88-017256] N89-14393
Modeling of hydrogen-air diffusion flame N89-14913

**FUEL SPRAYS**
Analysis of transport mechanisms in dense fuel droplet sprays
[DE88-017256] N89-14393

**FUNCTIONS**
Sensor-based diagnosis using knowledge of structure and function N89-14770

**FUNCTIONS (MATHEMATICS)**
Approximation methods for the consistent initialization of differential-algebraic equations
[DE88-017316] N89-14781

**FUSION REACTORS**
The moon: An abundant source of clean and safe fusion fuel for the 21st century N89-14843
Helium-3 blankets for tritium breeding in fusion reactors N89-14844
Status of fusion research and implications for D/He-3 systems N89-14845
Review projects for the US Fusion Program
[DE88-017306] N89-14856
High temperature blankets for non-electrical/electrical applications of fusion reactors
[DE88-017307] N89-14857

**FUZZY SETS**
Cloud classification from satellite data using a fuzzy sets algorithm: A polar example
[NASA-CR-184568] N89-14708

## G

**GALACTIC CLUSTERS**
Linear clusters of galaxies N89-15050
A study of environmental influences on the structure of spiral galaxy disks N89-15051

**GALACTIC COSMIC RAYS**
Benchmark solutions for the galactic ion transport equations with spatial and energy coupling N89-14907
Preliminary estimates of galactic cosmic ray shielding requirements for manned interplanetary missions
[NASA-TM-101516] N89-15070

**GALACTIC EVOLUTION**
Linear clusters of galaxies N89-15050
A study of environmental influences on the structure of spiral galaxy disks N89-15051

**GALACTIC NUCLEI**
Studies of the interstellar medium in the inner galaxy at 21 centimeters N89-15055

**GALAXIES**
CO and IRAS FIR emission in interacting galaxies
N89-15058

**GALERKIN METHOD**
On Hilbert-Schmidt norm convergence of Galerkin approximation for operator Riccati equations
[NASA-CR-181755] N89-14798

**GALLIUM**
Preparation, structure, and spectroscopic properties of nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 crystals
[AD-A198476] N89-14883
The Baksan Neutrino Observatory Soviet-American Gallium Solar Neutrino Experiment
[DE89-000375] N89-15061

**GALLIUM ARSENIDES**
Monolithic two-dimensional surface-emitting arrays of GaAs/AlGaAs diode lasers N89-14343
New MBE buffer for micron- and quarter-micron-gateGaAs MESFETs N89-14346
Rugged, thin GaAs solar cell development
[AD-A198533] N89-14502
Inversion boundaries in GaAs grown on Si
[DE89-000568] N89-14875
Photonic applications of thin film GaAs grown on silicon and insulating substrates by molecular beam epitaxy
[DE88-016975] N89-14877
Long-lived resonance states in Si-doped AlGaAs
[DE89-000305] N89-14879
Solid phase equilibria in the Pt-Ga-As and Pt-Ga-Sb systems
[AD-A198654] N89-14887

**GAMMA RAY BURSTS**
Disk accretion onto weakly magnetized neutron stars N89-15057
Pair production and annihilation in gamma-ray bursts N89-15065

**GAMMA RAYS**
Application of linear response theory to experimental data of simultaneous radiation and annealing response of a CMOS device [NASA-CR-183401] N89-14871
Gamma rays from Cygnus X-1: New diagnostics for a black hole [DE88-016275] N89-15067

**GARNETS**
Preparation, structure, and spectroscopic properties of nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 crystals [AD-A198476] N89-14883

**GAS ANALYSIS**
Measurements of ozone in the Antarctic region during August and September of 1987 N89-14552
Southern Hemispheric nitrous oxide measurements obtained during 1987 airborne Antarctic ozone experiment N89-14557
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic N89-14577
CANOZE measurements of the Arctic ozone hole N89-14578
Assessing the risks of trace gases that can modify the stratosphere. Volume 1: Executive summary [PB88-231055] N89-14610
Assessing the risks of trace gases that can modify the stratosphere. Volume 6: Technical support documentation production projections [PB88-231071] N89-14611
Assessing the risks of trace gases that can modify the stratosphere. Volume 7: Technical support documentation atmospheric science papers [PB88-231089] N89-14612
Assessing the risks of trace gases that can modify the stratosphere. Volume 8: Technical support documentation ozone depletion and plants [PB88-231097] N89-14613

**GAS CHROMATOGRAPHY**
Gas chromatographic and spectroscopic studies of cobalt(II) and other selected transition metal chelates of tetradentate beta-ketoenamines N89-14269
Trace analysis by capillary gas chromatography: Theory and methods [B8811770] N89-14289
Trace gas measurements from whole air samples collected over the Antarctic continent N89-14561

**GAS DETECTORS**
In situ observations of BrO over Antarctica: ER-2 aircraft results from 54 S to 72 S latitude N89-14583

**GAS EXCHANGE**
Influence of high temperature on total gas metabolism of animals with limitation of motor activity N89-14661

**GAS IONIZATION**
Ionization rates relevant to laser cooling of hydrogen [AD-A198481] N89-14440

**GAS JETS**
Underexpanded noncondensing turbulent gas jets in liquids [AD-A197939] N89-14396
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet [AD-A198360] N89-14399

**GAS MIXTURES**
Basic studies of gases for fast switches [AD-A198641] N89-14383
Retrieval of atmospheric temperatures and gas volume mixing ratios and column amounts from infrared solar absorption spectra [PB88-236153] N89-14622
Transient heat transfer from shrinking LOX-drop N89-14916

**GAS SPECTROSCOPY**
Gas chromatographic and spectroscopic studies of cobalt(II) and other selected transition metal chelates of tetradentate beta-ketoenamines N89-14269

**GAS TURBINES**
Plotting component maps in the Navy/NASA Engine Program (NNEP): A method and its usage [NASA-TM-101433] N89-14239
Some composite bearing and seal materials for gas turbine applications: A review [NASA-TM-101451] N89-14338
Heat flux measurements [NASA-TM-101426] N89-14418

**GAS-ION INTERACTIONS**
Reactions of metal ions and their clusters in the gas phase using laser ionization-Fourier transform mass spectrometry [DE88-017281] N89-14431

**GAS-SOLID INTERACTIONS**
Molecular beam studies of surface phonons and gas surface interactions [AD-A198435] N89-14826

**GASEOUS FUELS**
Aircraft emissions characterization [AD-A197864] N89-14617

**GASEOUS SELF-DIFFUSION**
Analysis of hydrogen diffusion and trapping in a 13 percent chromium martensitic stainless steel [NPL-DMA(A)-158] N89-14301

**GASES**
Constitutive relations for rapidly sheared granular flows: A Monte Carlo form based on the kinetic theory of dense gases N89-14387
Mixing ratios of trace gases in the austral polar atmosphere during August and September of 1987 N89-14556
Observations of stratospheric source gas profiles during the Arctic winter N89-14573
Rocket- and aircraft-borne trace gas measurements in the winter polar stratosphere N89-14574
Collision phenomena in a quantum gas [B8811778] N89-14829
The effects of biomass burning on the concentration of trace gases in the atmosphere N89-14904

**GATES (CIRCUITS)**
New MBE buffer for micron- and quarter-micron-gateGaAs MESFETs N89-14346

**GEAR TEETH**
The role of thermal and lubricant boundary layers in the transient thermal analysis of spur gears [NASA-TM-101435] N89-14452
Tooth contact shift in loaded spiral bevel gears o, IL, 25-27 Apr. 1989; sposored by ASME [NASA-TM-101438] N89-14453

**GELS**
A synthetic route to organic aerogels: Mechanism, structure, and properties [DE88-017112] N89-14317

**GENETIC ENGINEERING**
Firefly luciferase-structure and function [AD-A198292] N89-14283

**GEODESY**
NASA geodynamics program summary report, 1979-1987 progress and future outlook [NASA-TM-4065] N89-14476
On the connection of geodetic point fields in Reseau European Trigonometrique (RETRIG) and related tests for model errors [ETN-89-93327] N89-14485
On the connection of digitized maps to a uniform coordinate system. A special case of the geodetic connection problem [B8821602] N89-14487
A study on least-squares prediction and collocation --- geodesy [ETN-89-93336] N89-14492
Very Long Baseline Interferometry (VLBI): Relativity and geodesy [ETN-89-93337] N89-14493

**GEODETIC ACCURACY**
On the connection of geodetic point fields in Reseau European Trigonometrique (RETRIG) and related tests for model errors [ETN-89-93327] N89-14485

**GEODETIC COORDINATES**
Variance components estimation in two dimensional geodetic networks [ETN-89-93332] N89-14489

**GEODETIC SATELLITES**
Homogeneous plate deformation as monitored by Satellite Laser Ranging (SLR) and analyzed using 3D affine transformation models [B8821604] N89-14488

**GEODETIC SURVEYS**
Aspects of inertial investigation using a strapdown system [ETN-89-93335] N89-14229
Determination of convergence rates across the Ventura Basin, Southern California, using GPS and historical triangulation [NASA-CR-183014] N89-14624

**GEODYNAMICS**
NASA geodynamics program summary report, 1979-1987 progress and future outlook [NASA-TM-4065] N89-14476

**GEOGRAPHIC INFORMATION SYSTEMS**
Remote sensing technologies and spatial data applications [AD-A195809] N89-14480
Remote sensing information sciences research group [NASA-CR-183374] N89-14481

**GEOLOGICAL SURVEYS**
Geologic mapping in the US Geological Survey [PB88-223870] N89-14477

**GEOMAGNETISM**
Kiruna geophysical data: Data summary Oct. - Dec. 1987 [PB88-236633] N89-14623
Geomagnetic survey of the Netherlands, reduced to 1985 [KNMI-TR-109] N89-14632

**GEOMETRY**
B-spline-Bezier representation of tau-splines [AD-A197937] N89-14791

**GEOMORPHOLOGY**
Scientific results of the NASA-sponsored study project on Mars: Evolution of its climate and atmosphere [NASA-TM-101207] N89-15059

**GEOPHYSICS**
New absolute gravity instruments for physics and geophysics N89-14404
Kiruna geophysical data: Data summary Oct. - Dec. 1987 [PB88-236633] N89-14623
Investigation of the enhanced spatial density of submicron lunar ejecta between L values 1.2 and 3.0 in the earth's magnetosphere: Theory N89-15007

**GEOPOTENTIAL HEIGHT**
NMC stratospheric analyses during the 1987 Antarctic expedition N89-14511

**GEOPOTENTIAL RESEARCH MISSION**
Simulation and analysis of a Geopotential Research Mission N89-14478

**GEOSYNCHRONOUS ORBITS**
Control of the flexible modes of an advanced technology geostationary platform N89-14902

**GERMANIUM**
Rugged, thin GaAs solar cell development [AD-A198533] N89-14502

**GLOBAL POSITIONING SYSTEM**
Determination of convergence rates across the Ventura Basin, Southern California, using GPS and historical triangulation [NASA-CR-183014] N89-14624
Mapping experiment with space station N89-15046

**GLOW DISCHARGES**
Modeling of RF plasmas in a parallel plate etch reactor [B8811775] N89-14865

**GOALS**
The USL NASA PC R and D project: General specifications of objectives [NASA-CR-184534] N89-14974
The USL NASA PC R and D project: Detailed specifications of objects [NASA-CR-184540] N89-14980

**GOES SATELLITES**
Texture-based cloud classification N89-14931

**GOODNESS OF FIT**
Estimation of parameters and the goodness-of-fit test for multivariate distributions for data presented as one-dimensional histograms [DE88-703697] N89-14803

**GOVERNMENT/INDUSTRY RELATIONS**
Welcome to Ames Research Center (1987 forum on Federal technology transfer) [NASA-TM-100088] N89-14995

**GRAIN BOUNDARIES**
Grain boundary phase equilibria in metallic systems [DE89-000026] N89-14294
Mechanical properties of dispersion strengthened copper: A comparison of braze cycle annealed and coarse grain microstructures [DE89-001061] N89-14296
Inversion boundaries in GaAs grown on Si [DE89-000568] N89-14875

**GRAIN SIZE**
Mechanical properties of dispersion strengthened copper: A comparison of braze cycle annealed and coarse grain microstructures [DE89-001061] N89-14296
Observations of condensation nuclei in the 1987 airborne Antarctic ozone experiment N89-14541
The initiation of grain movement by wind N89-15029

**GRAND UNIFIED THEORY**
Research Program in Elementary Particle Theory [DE88-017241] N89-14891

**GRANULAR MATERIALS**
Kinetics in a turbulent nebular cloud N89-15025
Nucleation and particle coagulation experiments in microgravity N89-15030
Grain dynamics in zero gravity N89-15038

**GRAPHIC ARTS**
Synthesis of graphical displays for tabular data [AD-A198979] N89-14707
Polygons, stars, and clusters: An investigation of polygon displays [AD-A198430] N89-14719

**GRAPHITIZATION**
Graphite fluoride fiber polymer composite material
[NASA-CASE-LEW-14472-1] N89-14259
**GRAPHS (CHARTS)**
A 3-D object recognition system using aspect graphs
[AD-A198472] N89-14720
**GRASSLANDS**
The influence of grazing on land surface climatological variables
[NASA-CR-183308] N89-14637
**GRAVIMETRY**
New absolute gravity instruments for physics and geophysics N89-14404
Numerical optimization
[AD-A198586] N89-14793
**GRAVITATION**
Laser clocks and near field gravity of rotating objects N89-14911
**GRAVITATIONAL EFFECTS**
New absolute gravity instruments for physics and geophysics N89-14404
Falling antimatter: An experiment to measure the gravitational acceleration of the antiproton
[DE89-000313] N89-14892
Planetary impact experimentation N89-14999
Particle formation and interaction N89-15001
Low-gravity impact experiments: Progress toward a facility definition N89-15009
Impact experimentation and the microgravity environment: An overview N89-15016
Exobiology experiment concepts for Space Station N89-15017
Sediment-transport experiments in zero-gravity N89-15020
Design and calibration of the carousel wind tunnel N89-15021
Development and testing of a unique carousel wind tunnel to experimentally determine the effect of gravity and the interparticle force on the physics of wind-blown particles
[WHITE, BRUCE R.] N89-15022
Electrostatic aggregation of finely-comminuted geological materials N89-15027
Low-gravity facilities for Space Station planetology experiments N89-15032
Textural evolution of partially-molten planetary materials in microgravity N89-15037
Aeolian processes aboard a Space Station: Saltation and particle trajectory analysis N89-15039
A system for conducting igneous petrology experiments under controlled redox conditions in reduced gravity N89-15040
**GRAVITATIONAL FIELDS**
Falling antimatter: An experiment to measure the gravitational acceleration of the antiproton
[DE89-000313] N89-14892
On a solution of the Einstein gravitation equation for dust matter
[DE88-703739] N89-14893
Mapping experiment with space station N89-15046
**GRAZING INCIDENCE**
Specular reflection coefficient of snow at 10, 35 and 94 GHz as a function of grazing angle (Oberjettenberg-Campaign)
[FEL-1988-01] N89-14495
**GREEN'S FUNCTIONS**
Green's function Monte Carlo calculations of 4He
[DE89-000379] N89-14802
**GREENHOUSE EFFECT**
Stratospheric feedback from continued increases in tropospheric methane N89-14606
The effects of biomass burning on the concentration of trace gases in the atmosphere N89-14904
**GREENLAND**
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
[AD-A198653] N89-14484
**GRID GENERATION (MATHEMATICS)**
Numerical grid generation and potential airfoil analysis and design
[AD-A197972] N89-14219
Improvement in finite element meshes: Heat transfer in an infinite cylinder
[NASA-TM-101410] N89-14450
Parallel heterogeneous mesh refinement for advective-diffusive equations
[DE88-017026] N89-14786
Single-grid spectral collocation for the Navier-Stokes equations
[NASA-CR-181754] N89-14799
**GROUND EFFECT (AERODYNAMICS)**
Thrust-reverser flow investigation on a twin-engine transport
[NASA-TP-2856] N89-14213
Investigation of a moving-model technique for measuring ground effect
[NASA-TM-4080] N89-14217
**GROUND STATIONS**
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic N89-14577
**GROUND SUPPORT EQUIPMENT**
Fabrication and testing of lightweight hydraulic system simulator hardware. Phase 2: Addendum
[AD-A198524] N89-14243
**GROUND SUPPORT SYSTEMS**
Development and use of interactive displays in real-time ground support research facilities
[NASA-TM-101694] N89-14683
Microgravity research in NASA ground-based facilities
[NASA-TM-101397] N89-15047
**GROUND WIND**
Some wind characteristics of Kahe Point, O'ahu and vicinity
[AD-A197969] N89-14644
**GROUP THEORY**
On the labeling and symmetry adaptation of the solvable finite groups representations
[DE88-703954] N89-14812
Semigroups of operators, approximation and saturation in Banach spaces
[ETN-89-93353] N89-14813
**GUSTS**
Calculation of the steadily periodic and gust responses of a hingeless rotor helicopter using two-dimensional time domain unsteady aerodynamics N89-14240
The measurement of gustiness at routine wind stations: A review
[KNMI-WR-87-11] N89-14646

## H

**HAFNIUM**
Oxidation behavior of FeAl+Hf,Zr,B
[NASA-TM-101402] N89-14297
**HALL EFFECT**
Transport and junction physics of semiconductor-metal eutectic composites
[AD-A198480] N89-14884
Offset reduction and three dimensional field sensing with magnetotransistors
[ETN-89-93349] N89-14890
**HALOGENS**
Simulation of the transport of halogen species from the equatorial and mid-latitude stratosphere to the polar stratosphere in a two-dimensional model N89-14595
**HAMILTONIAN FUNCTIONS**
On the labeling and symmetry adaptation of the solvable finite groups representations
[DE88-703954] N89-14812
**HARDENING**
Two-bar thermal ratchetting of annealed 2.25Cr-1Mo steel N89-14304
**HARMONIC FUNCTIONS**
An example of a harmonizable process whose spectral domain is not complete
[NASA-CR-184653] N89-14800
**HAZE**
Modelling the Antarctic ozone hole N89-14605
Scientific evaluation and assessment of ASL developed moist atmosphere models for low stratus subclouds
[AD-A198762] N89-14625
**HEAD MOVEMENT**
Eye and head motion during head turns in spaceflight
[NASA-TM-100466] N89-14676
Studies of the horizontal vestibulo-ocular reflex on STS 7 and 8
[NASA-TM-100468] N89-14677
**HEAT**
Low temperature heat capacities of several high strength materials
[AD-A198300] N89-14299
**HEAT EXCHANGERS**
Coupled three-dimensional conduction and natural convection heat transfer N89-14388
Capillary heat transport and fluid management device
[NASA-CASE-MFS-28217-1] N89-14392
**HEAT FLUX**
Heat flux measurements
[NASA-TM-101428] N89-14418
Use of operational analyses to study the dynamics of troposphere-stratosphere interactions in polar regions N89-14597
Heat flow and magnetization in the oceanic lithosphere
[NASA-CR-183346] N89-14653
**HEAT MEASUREMENT**
Low temperature heat capacities of several high strength materials
[AD-A198300] N89-14299
**HEAT TRANSFER**
Aerodynamic and kinetic processes in flames
[AD-A198474] N89-14284
A finite difference analysis of the heat transfer in periodic cavity flows N89-14389
Working fluid selection for space-based two-phase heat transport systems
[NASA-CR-183324] N89-14390
An advanced study of natural convection immersion cooling of a 3 x 3 array of simulated components in an enclosure filled with dielectric liquid
[AD-A197962] N89-14398
Improvement in finite element meshes: Heat transfer in an infinite cylinder
[NASA-TM-101410] N89-14450
High temperature blankets for non-electrical/electrical applications of fusion reactors
[DE88-017307] N89-14857
Transient heat transfer from shrinking LOX-drop N89-14916
**HEATING**
Modeling of transitional flows N89-14917
Electrical conductivity of carbonaceous chondrites and electric heating of meteorite parent bodies N89-15011
Experimental constraints on heating and cooling rates of refractory inclusions in the early solar system N89-15042
**HEAVY IONS**
Benchmark solutions for the galactic ion transport equations with spatial and energy coupling N89-14907
**HELICOPTER DESIGN**
Calculation of the steadily periodic and gust responses of a hingeless rotor helicopter using two-dimensional time domain unsteady aerodynamics N89-14240
**HELICOPTERS**
High lift, low pitching moment airfoils
[NASA-CASE-LAR-13215-1] N89-14224
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight
[NASA-CR-4212] N89-14821
**HELIUM**
Leakage predictions for Rayleigh-step, helium-purge seals
[NASA-TM-101352] N89-14255
Green's function Monte Carlo calculations of 4He
[DE89-000379] N89-14802
**HELIUM ISOTOPES**
Lunar Helium-3 and Fusion Power
[NASA-CP-10018] N89-14842
The moon: An abundant source of clean and safe fusion fuel for the 21st century N89-14843
Status of fusion research and implications for D/He-3 systems N89-14845
Strategy for D/He-3 fusion development N89-14846
Processes and energy costs for mining lunar Helium-3 N89-14848
Economic geology of lunar Helium-3 N89-14849
Mining for helium: Site selection and evaluation N89-14850
Synergism of He-3 acquisition with lunar base evolution N89-14852
Assessment of lunar sources of He-3 for use on earth N89-14853
**HELIUM-NEON LASERS**
An advanced study of natural convection immersion cooling of a 3 x 3 array of simulated components in an enclosure filled with dielectric liquid
[AD-A197962] N89-14398
**HEMODYNAMIC RESPONSES**
Functional significance and mechanisms of variability in baroreceptor reflex N89-14664
Systemic hemodynamic shifts in hypoxia N89-14665
**HERMES MANNED SPACEPLANE**
Transfer airlock requirements
[TAL-RP-SN-003] N89-14254
**HETEROCYCLIC COMPOUNDS**
Rheological and rheo-optical studies with nematogenic solutions of a rodlike polymer: A review of data on poly(phenylene benzobisthiazole)
[AD-A197994] N89-14318
**HETEROGENEITY**
Parallel heterogeneous mesh refinement for advective-diffusive equations
[DE88-017026] N89-14786
**HETEROJUNCTIONS**
Acoustic phonon scattering in modulation doped Aluminum (subx) Gallium (sub 1x) Arsenide/Gallium arsenide heterojunctions
[AD-A198512] N89-14885

**HEURISTIC METHODS**
Ordering methods for sparse matrices and vector computers
| AD-A198291 | N89-14717
Queuing network models and performance analysis of computer systems
| B8811769 | N89-14738
**HIERARCHIES**
An hierarchical approach to performance evaluation of expert systems
| NASA-CR-184527 | N89-14967
**HIGH ALTITUDE**
Current induced by HEMP (High-Altitude Electromagnetic Pulse) on wire above ground
| PB88-212048 | N89-14353
**HIGH ENERGY INTERACTIONS**
Evolution of photon and particle spectra in compact, luminous objects
| NASA-TM-101247 | N89-14825
**HIGH POWER LASERS**
High-power AlGaAs channeled substrate planar diode lasers for spaceborne communications
| NASA-CR-4189 | N89-14426
**HIGH PRESSURE**
Ultrasonic depth gauge for liquids under high pressure
| NASA-CASE-LAR-13300-1-CU | N89-14407
Containerless high-pressure petrology experiments in the microgravity environment of the Space Station N89-15045
**HIGH RESOLUTION**
Modern computer-aided tools for high-resolution weapons system engineering
| AD-A197855 | N89-14710
A hard X-ray spectrometer for high angular resolution observations of cosmic sources
| DE88-017005 | N89-15068
**HIGH REYNOLDS NUMBER**
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet
| AD-A198360 | N89-14399
**HIGH SPEED**
Application of Fabry-Perot velocimeter to high-speed experiments
| DE88-016269 | N89-14410
High-Speed Microphotographic Laboratory
| DE88-017009 | N89-14411
Pressure measuring probe
| NASA-CASE-LAR-13853-1 | N89-14423
**HIGH STRENGTH STEELS**
Fracture behaviour under impact 2
| AD-A198643 | N89-14467
**HIGH TEMPERATURE**
Development of a microcircuit grid technique for automated crack length measurement for fatigue testing at elevated temperature
| AD-A198003 | N89-14463
Digital image analysis system for monitoring crack growth at elevated temperature
| AD-A198649 | N89-14468
High temperature blankets for non-electrical/electrical applications of fusion reactors
| DE88-017307 | N89-14857
Crystal-liquid-vapor equilibrium experiments at high temperature (less than or equal to 1800 C) and low, controlled oxygen and hydrogen pressure (10(-1) to 10(-9) PA) N89-15028
**HIGH TEMPERATURE ENVIRONMENTS**
Influence of high temperature on total gas metabolism of animals with limitation of motor activity N89-14661
**HIGH TEMPERATURE SUPERCONDUCTORS**
Stability of bulk Ba2YCu3O(7-x) in a variety of environments
| NASA-TM-101401 | N89-14310
Magnetic field penetration into the high temperature superconductor YBa2Cu3O(sub 7-x)
| DE89-000547 | N89-14873
Effects of electron irradiation on high temperature superconductors and contacts to high temperature superconductors N89-14900
**HIGHLY MANEUVERABLE AIRCRAFT**
Autonomous RPRV navigation, guidance and control
| NASA-CR-179425 | N89-14228
**HILBERT SPACE**
On Hilbert-Schmidt norm convergence of Galerkin approximation for operator Riccati equations
| NASA-CR-181755 | N89-14798
**HISTOGRAMS**
Estimation of parameters and the goodness-of-fit test for multivariate distributions for data presented as one-dimensional histograms
| DE88-703697 | N89-14803
**HISTORIES**
US photovoltaic patents, 1951--1987
| DE88-001178 | N89-14497
Curriculum in aerospace science and technology in cooperation with NASA Langley Research Center N89-14908
**HOHLRAUMS**
Automated data acquisition and processing for a Hohlraum reflectometer
| NASA-TM-101393 | N89-14416
**HOLES (MECHANICS)**
Temperature effect on stress concentration around circular hole in a composite material specimen representative of X-29A forward-swept wing aircraft
| NASA-CR-179439 | N89-14456
**HOLOGRAPHIC INTERFEROMETRY**
Quantitative holographic interferometry: Measurement of solid object deformations
| ETN-89-93351 | N89-14420
Holographic recording of deformation waves in muscle tissue N89-14660
**HOLOGRAPHY**
Progress and prospects in soft X-ray holographic microscopy
| DE88-016638 | N89-14409
**HORIZONTAL ORIENTATION**
Studies of the horizontal vestibulo-ocular reflex on STS 7 and 8
| NASA-TM-100468 | N89-14677
**HOT CORROSION**
Castable hot corrosion resistant alloy
| NASA-CASE-LEW-14134-2 | N89-14303
**HOT PRESSING**
Mechanical property enhancement in ceramic matrix composites
| PB88-232863 | N89-14257
**HOUSINGS**
Investigation of RF excited CW CO2 waveguide lasers local oscillator - RF excitation
| NASA-CR-183344 | N89-14427
Dynamic analysis of nonlinear rotor-housing systems
| NASA-CR-184611 | N89-14449
**HUBBLE SPACE TELESCOPE**
Knowledge-based analysis of telemetry data on the Hubble space telescope N89-14751
**HUMAN BEINGS**
Perceptual factors in workload: A neuromagnetic study
| AD-A198487 | N89-14681
**HUMAN BODY**
Circumferential pressure probe
| NASA-CASE-LAR-13775-1 | N89-14408
Articulated total body model enhancements. Volume 1: Modifications
| AD-A198726 | N89-14685
Articulated total body model enhancements. Volume 3: Programmer's guide
| AD-A197940 | N89-14688
**HUMAN FACTORS ENGINEERING**
Workload for air combat and air traffic controllers
| IZF-1987-32 | N89-14230
Mental models for time displayed tasks
| AD-A198536 | N89-14682
Human factors in the Naval Air Systems Command: Computer based training
| DE88-015301 | N89-14686
Computation via direct manipulation
| AD-A198417 | N89-14690
Polygons, stars, and clusters: An investigation of polygon displays
| AD-A198430 | N89-14719
**HUMAN PERFORMANCE**
Polygons, stars, and clusters: An investigation of polygon displays
| AD-A198430 | N89-14719
**HUMAN REACTIONS**
Social sciences and space exploration
| EP-192 | N89-14895
**HUMIDITY MEASUREMENT**
Scientific evaluation and assessment of ASL developed moist atmosphere models for low stratus subclouds
| AD-A198762 | N89-14625
**HYDRAULIC EQUIPMENT**
Fabrication and testing of lightweight hydraulic system simulator hardware. Phase 2: Addendum
| AD-A198524 | N89-14243
**HYDROCARBONS**
Aircraft emissions characterization
| AD-A197864 | N89-14617
**HYDROCHLORIC ACID**
Formation of polar stratospheric clouds simulated in a two dimensional model of the atmosphere N89-14529
**HYDRODYNAMICS**
Analysis of electrophoresis performance
| NASA-CR-183508 | N89-14265
An investigation into fluid film lubrication in dynamically loaded bearings N89-14442
**HYDROGEN**
Analysis of hydrogen diffusion and trapping in a 13 percent chromium martensitic stainless steel
| NPL-DMA(A)-158 | N89-14301
Laser-driven polarized sources of hydrogen and deuterium
| DE89-000541 | N89-14432
Ionization rates relevant to laser cooling of hydrogen
| AD-A198481 | N89-14440
Study of the localized vibrations of the hydrogen in solid solution Zr-O by inelastic neutron scattering
| DE88-702945 | N89-14866
Modeling of hydrogen-air diffusion flame N89-14913
Pretreatment of CO oxidation catalysts N89-14930
**HYDROGEN ATOMS**
Collision phenomena in a quantum gas
| B8811778 | N89-14829
**HYDROGEN IONS**
Implantation studies of hydrogen by field ion microscopy and spectroscopy
| DE88-016020 | N89-14293
**HYDROGEN MASERS**
Investigation of the hydrogen source for masers
| PB88-225685 | N89-14424
**HYDROGEN PRODUCTION**
Lunar hydrogen: A resource for future use at lunar bases and space activities N89-14847
High temperature blankets for non-electrical/electrical applications of fusion reactors
| DE88-017307 | N89-14857
**HYDROLOGICAL CYCLE**
Large scale features of the atmospheric water vapor transport over the Amazon Region N89-14620
**HYDROLOGY MODELS**
Remote sensing technologies and spatial data applications
| AD-A195809 | N89-14480
**HYDROPHONES**
A national intercomparison of hydrophone calibration methods
| NPL-AC-116 | N89-14819
**HYPERCAPNIA**
Effects of low and high oxygen tensions and related respiratory conditions on visual performance: A literature review
| AD-A198688 | N89-14669
**HYPERCUBE MULTIPROCESSORS**
High performance parallel computers for science: New developments at the Fermilab Advanced Computer Program
| DE88-016465 | N89-14733
**HYPERGEOMETRIC FUNCTIONS**
Connected part of the covariant Tate p-divisible group and the zeta-function of the family of hyperelliptic curves y sup 2 = 1 + mu(chi sup N) modulo various primes
| PB88-226659 | N89-14777
**HYPEROXIA**
Effects of low and high oxygen tensions and related respiratory conditions on visual performance: A literature review
| AD-A198688 | N89-14669
**HYPERSONIC AIRCRAFT**
Materials and structures for hypersonic vehicles
| NASA-TM-101501 | N89-14264
**HYPERSONIC BOUNDARY LAYER**
Modeling of transitional flows N89-14917
**HYPERVELOCITY GUNS**
Ultra-high velocity, HE-driven projectile launchers
| DE88-015429 | N89-14246
**HYPERVELOCITY IMPACT**
A planetary ultra hypervelocity impact mechanics and shock wave science facility N89-15005
**HYPERVELOCITY LAUNCHERS**
Application of Fabry-Perot velocimeter to high-speed experiments
| DE88-016269 | N89-14410
**HYPERVELOCITY PROJECTILES**
A planetary ultra hypervelocity impact mechanics and shock wave science facility N89-15005
**HYPERVENTILATION**
An inquiry into panic and its differentiation from other types of anxiety N89-14679
**HYPOCAPNIA**
Effects of low and high oxygen tensions and related respiratory conditions on visual performance: A literature review
| AD-A198688 | N89-14669
**HYPOKINESIA**
Effects of calcitonin and retabolil on rat femur in hypokinesia N89-14659
Influence of emotional-pain stress on contractile function of myocardium during long-term hypokinesia N89-14662
**HYPOXIA**
Correction of acute hypoxia-induced changes in blood coagulation in rabbits N89-14663

Systemic hemodynamic shifts in hypoxia N89-14665
Effects of low and high oxygen tensions and related respiratory conditions on visual performance: A literature review
[AD-A198688] N89-14669

## I

**IBM COMPUTERS**
A performance evaluation of the IBM 370/XT personal computer
[NASA-CR-184542] N89-14982
**ICE FORMATION**
Evaluation of the improved OV-1D anti-icing system
[AD-A198438] N89-14225
A numerical simulation of the full two-dimensional electrothermal de-icer pad
[NASA-CR-4194] N89-14235
Evolution of polar stratospheric clouds during the Antarctic winter N89-14534
Physical processes in polar stratospheric ice clouds N89-14536
Heterogeneous chemistry related to Antarctic ozone depletion: Reaction of ClONO2 and N2O5 on ice surfaces N89-14537
Mass accommodation coefficient measurements for HNO3, HCl and N2O5 on water, ice and aqueous sulfuric acid droplet surfaces N89-14538
Laboratory studies of sticking coefficients and heterogeneous reactions important in the stratosphere N89-14539
**ICE NUCLEI**
Ice in the Antarctic polar stratosphere N89-14530
Observations of condensation nuclei in the 1987 airborne Antarctic ozone experiment N89-14541
**ICE PREVENTION**
Evaluation of the improved OV-1D anti-icing system
[AD-A198438] N89-14225
A numerical simulation of the full two-dimensional electrothermal de-icer pad
[NASA-CR-4194] N89-14235
**ICELAND**
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
[AD-A198653] N89-14484
**IDEAL GAS**
Dynamics of unbound vortices in the 2-dimensional XY and anisotropic Heisenberg models
[DE89-000371] N89-14394
**IDENTIFYING**
The influence of and the identification of nonlinearity in flexible structures N89-14932
**IGNITION**
Discussion and explanation of unplanned ignition incident: Ignition caused by rapid pressurization of a propellant containing bubbles
[AD-A198419] N89-14340
**IGNITION SYSTEMS**
Engines for Mini-RPV XM-1A
[AD-A198336] N89-14236
**IMAGE ANALYSIS**
Digital image analysis system for monitoring crack growth at elevated temperature
[AD-A198649] N89-14468
**IMAGE INTENSIFIERS**
Detector evaluation for optical signals
[AD-A198133] N89-14836
**IMAGE PROCESSING**
Digital image analysis system for monitoring crack growth at elevated temperature
[AD-A198649] N89-14468
Remote sensing technologies and spatial data applications
[AD-A195809] N89-14480
Remote sensing information sciences research group
[NASA-CR-183374] N89-14481
Precision of line following in digital images
[B8821610] N89-14486
Automatic procedure to find corresponding points in CCD Airborne Experimental Scanner for Applications in Remote sensing (CAESAR) images
[B8821609] N89-14490
FRANK: Some aspects of the processing of observations using the interpretation instrument; measuring methods, instrumental errors and preprocessing of the observations --- FRANK; a system for photographic registration of topography for analog image presentation and map manufacturing
[ETN-89-93338] N89-14494
Research instrumentation for computer vision, image understanding and optical computing
[AD-A198578] N89-14723
Optical predetection processing for partially coherent systems N89-14815
Texture-based cloud classification N89-14931
**IMAGES**
Dynamics Explorer 1 SOI images of the Antarctic ozone hole N89-14515
Perceptual factors in workload: A neuromagnetic study
[AD-A198487] N89-14681
**IMAGING TECHNIQUES**
Monochromatic imaging studies of a low pressure arc burning on molten Inconel 718 alloy electrodes during vacuum arc remelting
[DE88-012855] N89-14292
The influence of grazing on land surface climatological variables
[NASA-CR-183308] N89-14637
Optical predetection processing for partially coherent systems N89-14815
Mapping experiment with space station N89-15046
**IMPACT**
Fracture behaviour under impact 2
[AD-A198643] N89-14467
Planetary impact experimentation N89-14999
Proposed earth-based cratering experiments at low g in hard vacuum N89-15006
Impact cratering in reduced-gravity environments: Early experiments on the NASA KC-135 aircraft N89-15008
Low-gravity impact experiments: Progress toward a facility definition N89-15009
Impact experimentation and the microgravity environment: An overview N89-15016
Debris-cloud collisions: Accretion studies in the Space Station N89-15033
Impacts of free-floating objects: Unique Space Station experiments N89-15034
**IMPACT LOADS**
Shock response spectrum anomalies which occur due to imperfections in the data
[DE88-015846] N89-14459
GREEDI: The computerization of the DOE/DOD environmental data bank
[DE88-014965] N89-14941
**IMPACT TESTS**
Application of Fabry-Perot velocimeter to high-speed experiments
[DE88-016269] N89-14410
**IMPEDANCE**
Determining conductivity by boundary measurements: Some numerical results
[AD-A198014] N89-14792
**IMPLICATION**
Technology and physics implications of oscillating-field current drive in reversed-field pinches
[DE89-000388] N89-14861
**IMPULSES**
Impulse response of a frequency-dependent delay
[DE88-004793] N89-14368
**IN-FLIGHT MONITORING**
A flight expert system (FLES) for on-board fault monitoring and diagnosis N89-14753
**INCLUSIONS**
Experimental constraints on heating and cooling rates of refractory inclusions in the early solar system N89-15042
**INCOHERENT SCATTERING**
Spontaneous and induced coherent radiation generated in atomic vapor
[AD-A198060] N89-14282
**INCONEL (TRADEMARK)**
Monochromatic imaging studies of a low pressure arc burning on molten Inconel 718 alloy electrodes during vacuum arc remelting
[DE88-012855] N89-14292
**INDEXES (DOCUMENTATION)**
Center for Electronics and Electrical Engineering technical progress bulletin covering Center programs, October to December 1987 with 1988 CEEE events calendar
[PB88-232913] N89-14375
Analysis of crop loss for alternative ozone exposure indices
[PB88-214788] N89-14608
An overview of the USL/DBMS NASA/PC R and D project working paper series
[NASA-CR-184533] N89-14973
**INDUCTANCE**
Current induced by HEMP (High-Altitude Electromagnetic Pulse) on wire above ground
[PB88-212048] N89-14353
**INDUSTRIES**
Program solicitation closing date: July 22, 1988
[NASA-TM-101217] N89-14934
**INELASTIC SCATTERING**
Molecular beam studies of surface phonons and gas surface interactions
[AD-A198435] N89-14826
Semiclassical corrections for inelastic atom-surface scattering from classical trajectories
[AD-A198636] N89-14827
Study of the localized vibrations of the hydrogen in solid solution Zr-O by inelastic neutron scattering
[DE88-702945] N89-14866
**INERTIAL CONFINEMENT FUSION**
Status of fusion research and implications for D/He-3 systems N89-14845
Progress toward inertial fusion with light ion beams at Sandia National Laboratories
[DE88-016693] N89-14862
**INERTIAL NAVIGATION**
Aspects of inertial investigation using a strapdown system
[ETN-89-93335] N89-14229
**INFORMATION DISSEMINATION**
An overview of the USL/DBMS NASA/PC R and D project working paper series
[NASA-CR-184533] N89-14973
**INFORMATION PROCESSING (BIOLOGY)**
Information processing of complex sounds in the anteroventral cochlear nucleus
[AD-A198576] N89-14673
**INFORMATION RETRIEVAL**
Active information retrieval
[PB88-226642] N89-14938
DOE/DOD environmental data bank
[DE88-015262] N89-14942
Transportable educational programs for scientific and technical professionals: More effective utilization of automated scientific and technical data base systems
[NASA-CR-184507] N89-14947
USL/DBMS NASA/RECON working paper series. Standards
[NASA-CR-184508] N89-14948
Overview of the NASA/RECON educational, research, and development activities of the Computer Science Departments of the University of Southwestern Louisiana and Southern University
[NASA-CR-184509] N89-14949
NASA RECON: Course development, administration, and evaluation. A research and development proposal
[NASA-CR-184510] N89-14950
Transportable, university-level educational programs in interactive information storage and retrieval systems
[NASA-CR-184511] N89-14951
The man/machine interface in information retrieval: Providing access to the casual user
[NASA-CR-184512] N89-14952
A report on the USL NASA/RECON project. Part 1: The development of a transportable, university level, IS and R educational program
[NASA-CR-184515] N89-14955
A report on the USL NASA/RECON project. Part 2: PC-based R and D in support of IS and R applications
[NASA-CR-184516] N89-14956
An overview of selected information storage and retrieval issues in computerized document processing
[NASA-CR-184519] N89-14959
An innovative, multidisciplinary educational program in interactive information storage and retrieval
[NASA-CR-184520] N89-14960
An innovative, multidisciplinary educational program in interactive information storage and retrieval. Presentation visuals
[NASA-CR-184521] N89-14961
USL NASA/RECON project presentations at the 1985 ACM Computer Science Conference: Abstracts and visuals
[NASA-CR-184522] N89-14962
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems. Presentation visuals
[NASA-CR-184524] N89-14964
Natural language query system design for interactive information storage and retrieval systems
[NASA-CR-184525] N89-14965
Natural language query system design for interactive information storage and retrieval systems. Presentation visuals
[NASA-CR-184526] N89-14966
KARL: A Knowledge-Assisted Retrieval Language
[NASA-CR-184529] N89-14969
KARL: A Knowledge-Assisted Retrieval Language. Presentation visuals
[NASA-CR-184530] N89-14970
A survey of chemical information systems
[NASA-CR-184531] N89-14971
A methodology for the design and evaluation of user interfaces for interactive information systems
[NASA-CR-184532] N89-14972
An overview of the USL/DBMS NASA/PC R and D project working paper series
[NASA-CR-184533] N89-14973

The USL NASA PC R and D project: General specifications of objectives
[NASA-CR-184534] N89-14974
General specifications for the development of a PC-based simulator of the NASA RECON system
[NASA-CR-184536] N89-14976
General specifications for the development of a USL NASA PC R and D statistical analysis support package
[NASA-CR-184537] N89-14977
General specifications for the development of a USL/DBMS NASA/PC R and D distributed workstation
[NASA-CR-184538] N89-14978
Design criteria for a PC-based common user interface to remote information systems
[NASA-CR-184541] N89-14981
PC-based Multiple Information System Interface (PC/MISI) design plan
[NASA-CR-184547] N89-14987
PC-based Multiple Information System Interface (PC/MISI) detailed design and implementation plan
[NASA-CR-184548] N89-14988
An overview of the evaluation plan for PC/MISI: PC-based Multiple Information System Interface
[NASA-CR-184549] N89-14989

**INFORMATION SYSTEMS**
A maintenance and diagnostic information system N89-14754
PROMIS (Procurement Management Information System)
[NASA-CR-179395] N89-14933
DOE/DOD environmental data bank
[DE88-015262] N89-14942
Interactive access to scientific and technological factual databases worldwide
[DE88-016172] N89-14943
Transportable educational programs for scientific and technical professionals: More effective utilization of automated scientific and technical data base systems
[NASA-CR-184507] N89-14947
USL/DBMS NASA/RECON working paper series. Standards
[NASA-CR-184508] N89-14948
Overview of the NASA/RECON educational, research, and development activities of the Computer Science Departments of the University of Southwestern Louisiana and Southern University
[NASA-CR-184509] N89-14949
NASA RECON: Course development, administration, and evaluation. A research and development proposal
[NASA-CR-184510] N89-14950
Transportable, university-level educational programs in interactive information storage and retrieval systems
[NASA-CR-184511] N89-14951
The man/machine interface in information retrieval: Providing access to the casual user
[NASA-CR-184512] N89-14952
Concepts and implementations of natural language query systems
[NASA-CR-184514] N89-14954
A report on the USL NASA/RECON project. Part 1: The development of a transportable, university level, IS and R educational program
[NASA-CR-184515] N89-14955
A report on the USL NASA/RECON project. Part 2: PC-based R and D in support of IS and R applications
[NASA-CR-184516] N89-14956
Knowledge based systems: A critical survey of major concepts, issues and techniques. Visuals
[NASA-CR-184518] N89-14958
An overview of selected information storage and retrieval issues in computerized document processing
[NASA-CR-184519] N89-14959
An innovative, multidisciplinary educational program in interactive information storage and retrieval
[NASA-CR-184520] N89-14960
An innovative, multidisciplinary educational program in interactive information storage and retrieval. Presentation visuals
[NASA-CR-184521] N89-14961
USL NASA/RECON project presentations at the 1985 ACM Computer Science Conference: Abstracts and visuals
[NASA-CR-184522] N89-14962
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems
[NASA-CR-184523] N89-14963
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems. Presentation visuals
[NASA-CR-184524] N89-14964
Natural language query system design for interactive information storage and retrieval systems
[NASA-CR-184525] N89-14965
Natural language query system design for interactive information storage and retrieval systems. Presentation visuals
[NASA-CR-184526] N89-14966
KARL: A Knowledge-Assisted Retrieval Language. Presentation visuals
[NASA-CR-184530] N89-14970
A survey of chemical information systems
[NASA-CR-184531] N89-14971
A methodology for the design and evaluation of user interfaces for interactive information systems
[NASA-CR-184532] N89-14972
An overview of the USL/DBMS NASA/PC R and D project working paper series
[NASA-CR-184533] N89-14973
General specifications for the development of a PC-based simulator of the NASA RECON system
[NASA-CR-184536] N89-14976
The USL NASA PC R and D project: Detailed specifications of objects
[NASA-CR-184540] N89-14980
Design criteria for a PC-based common user interface to remote information systems
[NASA-CR-184541] N89-14981
A performance evaluation of the IBM 370/XT personal computer
[NASA-CR-184542] N89-14982
USL/DBMS NASA/PC R and D project C programming standards
[NASA-CR-184543] N89-14983
USL/DBMS NASA/PC R and D project system design standards
[NASA-CR-184544] N89-14984
IBM PC/IX operating system evaluation plan
[NASA-CR-184546] N89-14986
PC-based Multiple Information System Interface (PC/MISI) design plan
[NASA-CR-184547] N89-14987
PC-based Multiple Information System Interface (PC/MISI) detailed design and implementation plan
[NASA-CR-184548] N89-14988
An overview of the evaluation plan for PC/MISI: PC-based Multiple Information System Interface
[NASA-CR-184549] N89-14989
NASA PC software evaluation project
[NASA-CR-184550] N89-14990

**INFORMATION TRANSFER**
Overlapping grids for flow field calculations N89-14918

**INFRARED ABSORPTION**
Residual infrared absorption in Ti:Al2O3 crystals N89-14345

**INFRARED ASTRONOMY**
CO and IRAS FIR emission in interacting galaxies N89-15058

**INFRARED DETECTORS**
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
[AD-A198653] N89-14484
Hg,CdTe material optimization for carrier lifetime maximization
[AD-A198101] N89-14880

**INFRARED RADIATION**
Infrared temperature monitoring and control of final solder-joint temperature on flat flex cables
[DE89-000409] N89-14349
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
[AD-A198653] N89-14484
Optical and infrared properties of the marine atmosphere, phase 1
[FEL-1987-76] N89-14630
The circumstellar envelopes of young stellar objects and emission line stars N89-15066

**INFRARED RADIOMETERS**
Investigation of RF excited CW CO2 waveguide lasers local oscillator - RF excitation
[NASA-CR-183344] N89-14427
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
[AD-A198653] N89-14484

**INFRARED SPECTRA**
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
[AD-A198653] N89-14484
Infrared measurements of column amounts of stratospheric constituents in the Antarctic winter, 1987 N89-14545
Infrared aircraft measurements of stratospheric composition over Antarctica during September 1987 N89-14546
Infrared measurements in the spring 1987 ozone hole N89-14547
An FTIR spectrometer for remote measurements of atmospheric composition N89-14550
High resolution FTIR spectroscopy of the ClO radical N89-14607
Retrieval of atmospheric temperatures and gas volume mixing ratios and column amounts from infrared solar absorption spectra
[PB88-236153] N89-14622

**INFRARED SPECTROSCOPY**
Transient behaviors in chemical reactions: Nanosecond infrared spectroscopy, chemically pumped visible and near-IR lasers
[AD-A198484] N89-14286
High resolution FTIR spectroscopy of the ClO radical N89-14607

**INJECTION MOLDING**
Numerical simulation of injection molding: Non-isothermal non-Newtonian flow of polymers in complex geometries
[ETN-89-93348] N89-14727

**INLET FLOW**
Experimental results for a two-dimensional supersonic inlet used as a thrust deflecting nozzle
[NASA-TM-83439] N89-14386

**INSTRUMENT ERRORS**
Estimation of errors in the TOMS total ozone measurement during the Antarctica ozone campaign of August/September 1987 N89-14510

**INTEGRAL EQUATIONS**
Electromagnetic penetration through finite-length narrow slots in planar conducting screens
[DE88-016046] N89-14370
A direct iterative-variational method for solving large sets of linear algebraic equations
[DE88-016149] N89-14780

**INTEGRATED CIRCUITS**
Parallel processing techniques for the simulation of MOS VLSI circuits using waveform relaxation
[AD-A197879] N89-14734
Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics
[AD-A192453] N89-14740
Generating tests by exploiting designed behavior N89-14741
Reasoning about multiple faults N89-14743
Incorporating design for test into an IC design expert system N89-14746

**INTERACTIVE CONTROL**
System for the optimum design of structures
[ETN-89-93599] N89-14451

**INTERFACES**
Laser Doppler velocimeter multiplexer interface for simultaneous measured events
[NASA-CASE-ARC-11536-1] N89-14384
Qualitative aspects of seismograph/ocean bottom interaction
[AD-A198652] N89-14656
Analysis of FDDI synchronous traffic delays
[NASA-CR-183223] N89-14695
Processor and data bus interface analyses
[AD-A198801] N89-14696
Concepts and implementations of natural language query systems
[NASA-CR-184514] N89-14954
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems
[NASA-CR-184523] N89-14963
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems. Presentation visuals
[NASA-CR-184524] N89-14964
Some issues in data model mapping
[NASA-CR-184528] N89-14968

**INTERFACIAL ENERGY**
Bonding at metal-ceramic interfaces in hybrid materials
[AD-A197928] N89-14261

**INTERFEROMETRY**
On the size and composition of particles in polar stratospheric clouds N89-14528

**INTERNATIONAL COOPERATION**
Current achievements in cosmonautics
[NASA-TT-20365] N89-14245
ESA's activities report
[ISSN-0258-025X] N89-14937

**INTERNATIONAL SUN EARTH EXPLORERS**
Analysis of ISEE-3/ICE solar wind data
[NASA-CR-184652] N89-15063

**INTERPOLATION**
Development of the general interpolants method for the CYBER 200 series of supercomputers
[NASA-CR-4183] N89-14704

Universal limiter for transient interpolation modeling of the advective transport equations: The ULTIMATE conservative difference scheme
[NASA-TM-100916] N89-14794

**INTERPROCESSOR COMMUNICATION**
Random access algorithms for multiuser computer communication networks
[AD-A198090] N89-14713
VAMAS surface chemical analysis standard data transfer format with skeleton decoding programs
[NPL-DMA(A)-164] N89-14724

**INTERSECTIONS**
Computation of algebraic polynomial parametric surface intersections
[PB88-208277] N89-14778

**INTERSTELLAR CHEMISTRY**
Experiments in Planetary and Related Sciences and the Space Station
[NASA-CP-2494] N89-14993

**INTERSTELLAR MATTER**
Studies of the interstellar medium in the inner galaxy at 21 centimeters N89-15055

**INVARIANCE**
Superconformal algebras in two dimensions
[DE88-703786] N89-14790

**INVERSE SCATTERING**
Determination of optical properties by inversion of multiple scattering data: Experimental program
[AD-A198518] N89-14837

**INVERSIONS**
Inversion boundaries in GaAs grown on Si
[DE89-000568] N89-14875

**INVISCID FLOW**
Turbofan forced mixer lobe flow modeling. 2: Three-dimensional inviscid mixer analysis (FLOMIX)
[NASA-CR-4147-PT-2] N89-14222

**IODINE**
Iodine sorption study on the proposed use of Viton A in a shuttle galley water accumulator
[NASA-TM-100467] N89-14691

**ION ACCELERATORS**
Progress toward inertial fusion with light ion beams at Sandia National Laboratories
[DE88-016693] N89-14862

**ION BEAMS**
A fast ion beam pattern generator
[ETN-89-93354] N89-14350
Progress toward inertial fusion with light ion beams at Sandia National Laboratories
[DE88-016693] N89-14862

**ION IMPLANTATION**
Implantation studies of hydrogen by field ion microscopy and spectroscopy
[DE88-016020] N89-14293

**ION MICROSCOPES**
Implantation studies of hydrogen by field ion microscopy and spectroscopy
[DE88-016020] N89-14293

**IONIZATION**
Anelastic and thermal properties of ethylene/acrylic acid copolymers partially ionized with transition metals
[DE88-017006] N89-14316
Reactions of metal ions and their clusters in the gas phase using laser ionization-Fourier transform mass spectrometry
[DE88-017281] N89-14431

**IONIZING RADIATION**
Radiation sensitivity of soluble polysilane derivatives: Science and applications
[AD-A198805] N89-14313
Consideration of ionizing radiation shielding for optical fibers
[PB88-237029] N89-14817
Mechanisms of radiation damage generated by ionizing radiation in optical waveguides
[AD-A198030] N89-14834

**IONS**
Detection of ions by replacement-ion chromatography coupled to a microwave-induced nitrogen discharge at atmospheric pressure
[AD-A198800] N89-14273
Spectroscopic investigation of the Cr to Tm energy transfer in Yttrium Aluminum Garnet (YAG) crystals N89-14903

**IRON**
Electrochemical studies of molten glass N89-14266
Low temperature heat capacities of several high strength materials
[AD-A198300] N89-14299

**IRON ALLOYS**
The development of iron-aluminium based alloys for aqueous corrosion resistance N89-14291
DIMOD program complex for dynamic simulation of defects in metals and alloys
[DE88-703787] N89-14295
Oxidation behavior of FeAl+Hf,Zr,B
[NASA-TM-101402] N89-14297

**IRRADIANCE**
Daylight and twilight sky radiance and terrestrial irradiance
[AD-A198550] N89-14628

**IRRADIATION**
Stability of bulk Ba2YCu3O(7-x) in a variety of environments
[NASA-TM-101401] N89-14310
Block interrupt polysilane derivatives
[AD-A198804] N89-14312
Application of linear response theory to experimental data of simultaneous radiation and annealing response of a CMOS device
[NASA-CR-183401] N89-14871
Radiation effects on polymeric materials N89-14914

**ISOTOPE SEPARATION**
Chemical and Laser Sciences Division
[DE88-017140] N89-14274

**ISOTROPISM**
Rheological and rheo-optical studies with nematogenic solutions of a rodlike polymer: A review of data on poly(phenylene benzobisthiazole)
[AD-A197994] N89-14318

**ITERATIVE SOLUTION**
Numerical methods to solve the problem of scattering from electrically large bodies
[AD-A198098] N89-14359
A direct iterative-variational method for solving large sets of linear algebraic equations
[DE88-016149] N89-14780
Determining conductivity by boundary measurements: Some numerical results
[AD-A198014] N89-14792


## J


**JAPAN**
The birth of the second generation: The Hitachi S-820/80
[DE88-014439] N89-14697

**JET BOUNDARIES**
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet
[AD-A198360] N89-14399

**JET CONTROL**
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet
[AD-A198360] N89-14399

**JET FLOW**
Effects of core turbulence on jet excitability
[NASA-TM-101405] N89-14403

**JET PROPULSION**
Advanced core technology: Key to subsonic propulsion benefits
[NASA-TM-101420] N89-14237

**JOINTS (JUNCTIONS)**
Durability of adhesive joints: An engineering study
[PB88-233473] N89-14307
A general expression of Jacobian matrix and its simplified computation method: Relationships between the velocities of manipulator hand and joints
[DE88-754808] N89-14782
End-effector - joint conjugates for robotic assembly of large truss structures in space: A second generation N89-14898

**JOSEPHSON JUNCTIONS**
Josephson junction arrays with positional disorder: Experiments and simulations N89-14867

**JOULE-THOMSON EFFECT**
Joule Thomson refrigerator
[NASA-CASE-NPO-17143-1-CU] N89-14351

**JUDGMENTS**
Base rate effects on the interpretation of probability and frequency expressions
[AD-A198456] N89-14808


## K


**K-EPSILON TURBULENCE MODEL**
Two-equation low-Reynolds-number turbulence modeling of transitional boundary layer flows characteristic of gas turbine blades N89-14218

**KERATINS**
Methods of analysis of coupled spin-lattice relaxations and spin diffusion in heterogeneous organic solids with application to keratin N89-14823

**KETONES**
Studies of metal beta-diketonates by reversed-phase high performance liquid chromatography N89-14268
Gas chromatographic and spectroscopic studies of cobalt(II) and other selected transition metal chelates of tetradentate beta-ketoenamines N89-14269

**KINEMATICS**
Light weight high performance manipulators
[AD-A198647] N89-14448

**KINETIC HEATING**
The effect of high heating rate on the pyrolysis of polymeric and composite materials
[AD-A198052] N89-14319

**KINETIC THEORY**
Grain dynamics in zero gravity N89-15038

**KINETICS**
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product N89-14601
Electrical conductivity of carbonaceous chondrites and electric heating of meteorite parent bodies N89-15011
Kinetics of mineral condensation in the solar nebula N89-15019
Kinetics in a turbulent nebular cloud N89-15025

**KNOWLEDGE BASES (ARTIFICIAL INTELLIGENCE)**
The NC (Numerically Controlled) assistant: Interfacing knowledge based manufacturing tools to CAD/CAM systems
[DE88-016742] N89-14709
The integrated diagnostic model: Towards a second generation diagnostic expert system N89-14747
Knowledge-based analysis of telemetry data on the Hubble space telescope N89-14751
A maintenance and diagnostic information system N89-14754
Beyond rules: The next generation of expert systems N89-14759
MEND: A self-improving diagnostic with deep knowledge N89-14764
GDS: An intelligent diagnostic software shell N89-14766
A generic architecture for knowledge-based equipment fault diagnosis N89-14767
System integration of knowledge-based maintenance aids N89-14768
Sensor-based diagnosis using knowledge of structure and function N89-14770
Northeast Artificial Intelligence Consortium annual report 1986. Volume 3: Distributed artificial intelligence for communication network management
[AD-A197957] N89-14774
Knowledge based systems: A preliminary survey of selected issues and techniques
[NASA-CR-184513] N89-14953
Knowledge based systems: A critical survey of major concepts, issues, and techniques
[NASA-CR-184517] N89-14957
Knowledge based systems: A critical survey of major concepts, issues and techniques. Visuals
[NASA-CR-184518] N89-14958
KARL: A Knowledge-Assisted Retrieval Language
[NASA-CR-184529] N89-14969
KARL: A Knowledge-Assisted Retrieval Language. Presentation visuals
[NASA-CR-184530] N89-14970
The USL NASA PC R and D project: General specifications of objectives
[NASA-CR-184534] N89-14974

**KNOWLEDGE REPRESENTATION**
Beyond rules: The next generation of expert systems N89-14759
Knowledge based systems: A critical survey of major concepts, issues, and techniques
[NASA-CR-184517] N89-14957
Knowledge based systems: A critical survey of major concepts, issues and techniques. Visuals
[NASA-CR-184518] N89-14958
KARL: A Knowledge-Assisted Retrieval Language. Presentation visuals
[NASA-CR-184530] N89-14970

**KRYPTON FLUORIDE LASERS**
Chemical and Laser Sciences Division
[DE88-017140] N89-14274
High-energy UV laser experiments
[DE89-000505] N89-14437


## L


**LABORATORIES**
Solid state research
[NASA-CR-183328] N89-14342

**LABORATORY EQUIPMENT**
Touchstone for success: The Materials and Process Laboratories
[ESA-BR-52] N89-14244

**LACTATES**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
[AD-A197472] N89-14668

**LAMELLA**
Methods of analysis of coupled spin-lattice relaxations and spin diffusion in heterogeneous organic solids with application to keratin N89-14823

**LAMINATES**
Method of insetting predesigned disbond areas into composite laminates
[NASA-CASE-LAR-13225-1] N89-14258
Analytical and experimental characterization of damage processes in composite laminates
[AD-A198068] N89-14262

**LAND USE**
Geologic mapping in the US Geological Survey
[PB88-223870] N89-14477

**LANDING AIDS**
Autonomous RPRV navigation, guidance and control
[NASA-CR-179425] N89-14228

**LANTHANUM**
Reactions of metal ions and their clusters in the gas phase using laser ionization-Fourier transform mass spectrometry
[DE88-017281] N89-14431
Preparation, structure, and spectroscopic properties of nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 crystals
[AD-A198476] N89-14883

**LAPLACE TRANSFORMATION**
Benchmark solutions for the galactic ion transport equations with spatial and energy coupling N89-14907

**LARGE SPACE STRUCTURES**
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
[NASA-CR-181724] N89-14896
End-effector - joint conjugates for robotic assembly of large truss structures in space: A second generation N89-14898
Some test/analysis issues for the space station structural characterization experiment N89-14901
Extension and validation of a method for locating damaged members in large space trusses N89-14925

**LASER ANEMOMETERS**
Equipment to upgrade the facilities of the IIT (Illinois Institute of Technology) Fluid Dynamics Research Center
[AD-A198084] N89-14242

**LASER APPLICATIONS**
High-power AlGaAs channeled substrate planar diode lasers for spaceborne communications
[NASA-CR-4189] N89-14426
Ionization rates relevant to laser cooling of hydrogen
[AD-A198481] N89-14440
Laser clocks and near field gravity of rotating objects N89-14911

**LASER BEAMS**
Laser-driven polarized sources of hydrogen and deuterium
[DE89-000541] N89-14432
Electron acceleration by laser fields in a gas
[DE89-000567] N89-14433
Study of extreme ultraviolet laser sources for the guiding of particle beams
[DE88-008918] N89-14435

**LASER CAVITIES**
Electron-beam-pumped semiconductor lasers N89-14425

**LASER DOPPLER VELOCIMETERS**
Laser Doppler velocimeter multiplexer interface for simultaneous measured events
[NASA-CASE-ARC-11536-1] N89-14384
Frequency domain laser velocimeter signal processor
[NASA-CASE-LAR-13552-1-CU] N89-14385

**LASER GUIDANCE**
Study of extreme ultraviolet laser sources for the guiding of particle beams
[DE38-008918] N89-14435

**LASER INTERFEROMETRY**
Traceability of laser interferometric length measurements
[PB88-225677] N89-14405

**LASER OUTPUTS**
Method and apparatus for reducing speckle
[NASA-CASE-LAR-13771-1] N89-14428
Electron acceleration by laser fields in a gas
[DE89-000567] N89-14433
HANEX simulations of laser-target interactions: 1. Radiation processes
[AD-A197965] N89-14438
Semiconductor laser diodes and the design of a D.C. powered laser diode drivé unit
[AD-A198556] N89-14441
Determination of optical properties by inversion of multiple scattering data: Experimental program
[AD-A198518] N89-14837

**LASER PLASMA INTERACTIONS**
Laser generated large amplitude longitudinal fields in inhomogeneous plasma with second harmonic super density resonances and quasi-uniform coronal oscillations N89-14840

**LASER PLASMAS**
Laser generated large amplitude longitudinal fields in inhomogeneous plasma with second harmonic super density resonances and quasi-uniform coronal oscillations N89-14840

**LASER PUMPING**
Synchronously pumped mode-locked Ti:Al2O3 lasers N89-14344
Electron-beam-pumped semiconductor lasers N89-14425
Laser-driven polarized sources of hydrogen and deuterium
[DE89-000541] N89-14432

**LASER RANGE FINDERS**
Homogeneous plate deformation as monitored by Satellite Laser Ranging (SLR) and analyzed using 3D affine transformation models
[B8821604] N89-14488

**LASER SPECTROMETERS**
Development of laser-excited molecular luminescence spectrometric methods for aromatic hydrocarbons
[DE88-017305] N89-14276
Transient behaviors in chemical reactions: Nanosecond infrared spectroscopy, chemically pumped visible and near-IR lasers
[AD-A198484] N89-14286

**LASER SPECTROSCOPY**
The detection and study of molecular species using time resolved laser spectroscopy
[AD-A198482] N89-14285

**LASER TARGET INTERACTIONS**
HANEX simulations of laser-target interactions: 1. Radiation processes
[AD-A197965] N89-14438

**LASER WEAPONS**
Chemical and Laser Sciences Division
[DE88-017140] N89-14274

**LASERS**
Monolithic two-dimensional surface-emitting arrays of GaAs/AlGaAs diode lasers N89-14343
The electron laser facility: A millimeter wave free-electron laser amplifier
[DE88-016118] N89-14436

**LATITUDE**
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585

**LATTICE VIBRATIONS**
Study of the localized vibrations of the hydrogen in solid solution Zr-O by inelastic neutron scattering
[DE88-702945] N89-14866

**LAUNCH VEHICLES**
Transonic aeroelastic analysis of launch vehicle configurations
[NASA-CR-4186] N89-14215

**LAUNCHERS**
Ultra-high velocity, HE-driven projectile launchers
[DE88-015429] N89-14246

**LEAD (METAL)**
Effects of crucible wetting during solidification of immiscible Pb-Zn
[NASA-TM-101372] N89-14341

**LEAKAGE**
Leakage predictions for Rayleigh-step, helium-purge seals
[NASA-TM-101352] N89-14255

**LEARNING**
Living in space
[EP-222] N89-14684

**LEARNING THEORY**
Spacing effects in learning described by the SAM model. Comparing three versions of the SAM model
[PB88-204060] N89-14678

**LEAST SQUARES METHOD**
A study on least-squares prediction and collocation --- geodesy
[ETN-89-93336] N89-14492
Determining conductivity by boundary measurements: Some numerical results
[AD-A198014] N89-14792

**LENGTH**
Traceability of laser interferometric length measurements
[PB88-225677] N89-14405

**LEXAN (TRADEMARK)**
Radiation effects on polymeric materials N89-14914

**LIFE (DURABILITY)**
Two-bar thermal ratchetting of annealed 2.25Cr-1Mo steel N89-14304
Statistical characterization of carbon phenolic prepreg materials, volume 1
[NASA-CR-179416] N89-14306
Investigation of RF excited CW CO2 waveguide lasers local oscillator - RF excitation
[NASA-CR-183344] N89-14427

**LIFE SCIENCES**
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-87-008] N89-14658
Exobiology experiment concepts for Space Station N89-15017

**LIFTING ROTORS**
High lift, low pitching moment airfoils
[NASA-CASE-LAR-13215-1] N89-14224

**LIGANDS**
Studies of metal beta-diketonates by reversed-phase high performance liquid chromatography N89-14268

**LIGHT (VISIBLE RADIATION)**
Visible and near-ultraviolet spectroscopy at Thule AFB (76.5 N) from January 28 - February 15, 1988 N89-14576

**LIGHT AIRCRAFT**
Engines for Mini-RPV XM-1A
[AD-A198336] N89-14236

**LIGHT ALLOYS**
Low temperature heat capacities of several high strength materials
[AD-A198300] N89-14299

**LIGHT IONS**
Progress toward inertial fusion with light ion beams at Sandia National Laboratories
[DE88-016693] N89-14862

**LIGHT SCATTERING**
Determination of optical properties by inversion of multiple scattering data: Experimental program
[AD-A198518] N89-14837

**LIGHT TRANSMISSION**
Long term studies of the refractive index structure parameter in the troposphere and stratosphere
[AD-A198313] N89-14626

**LIKELIHOOD RATIO**
A note on extended quasi-likelihood
[AD-A198042] N89-14805

**LIMB DARKENING**
Summary of along-track data from the earth radiation budget satellite for several representative ocean regions
[NASA-RP-1206] N89-14634

**LIMITERS (FUSION REACTORS)**
Low activation materials for fusion
[DE88-015561] N89-14854
Edge-plasmas and wall protection in RFPs (Reversed-Field Pinch)
[DE89-000386] N89-14860

**LINE SPECTRA**
Retrieval of atmospheric temperatures and gas volume mixing ratios and column amounts from infrared solar absorption spectra
[PB88-236153] N89-14622

**LINEAR EQUATIONS**
A direct iterative-variational method for solving large sets of linear algebraic equations
[DE88-016149] N89-14780

**LINEAR PROGRAMMING**
Network management of highly adaptive communication networks
[AD-A198429] N89-14362
Numerical optimization
[AD-A198586] N89-14793

**LINEAR SYSTEMS**
Ordering methods for sparse matrices and vector computers
[AD-A198291] N89-14717
A split-Levinson approach to autoregressive modeling
[AD-A198535] N89-14722

**LINEARITY**
Rheological and rheo-optical studies with nematogenic solutions of a rodlike polymer: A review of data on poly(phenylene benzobisthiazole)
[AD-A197994] N89-14318
A note on second order effects in a semiparametric context
[AD-A198018] N89-14804

**LINEARIZATION**
Equivalent linearization for fatigue life estimates of a nonlinear structure N89-14919

**LIQUID CHROMATOGRAPHY**
Studies of metal beta-diketonates by reversed-phase high performance liquid chromatography N89-14268

**LIQUID COOLING**
An advanced study of natural convection immersion cooling of a 3 x 3 array of simulated components in an enclosure filled with dielectric liquid
[AD-A197962] N89-14398

**LIQUID CRYSTALS**
Rheological and rheo-optical studies with nematogenic solutions of a rodlike polymer: A review of data on poly(phenylene benzobisthiazole)
| AD-A197994 | N89-14318
Condensation polymers with controlled structure
| AD-A198086 | N89-14321
**LIQUID METALS**
Transient magnetohydrodynamic liquid-metal flows in a rectangular channel with a moving conducting wall
| AD-A197308 | N89-14841
**LIQUID OXYGEN**
Transient heat transfer from shrinking LOX-drop N89-14916
**LIQUID ROCKET PROPELLANTS**
Liquid Rocket Booster (LRB) for the Space Transportation System (STS) systems study. Study plan
| NASA-CR-179401 | N89-14249
**LIQUID-SOLID INTERFACES**
Effects of crucible wetting during solidification of immiscible Pb-Zn
| NASA-TM-101372 | N89-14341
Experimental studies of crystal-melt differentiation in planetary basalt compositions N89-15018
**LIQUIDS**
Underexpanded noncondensing turbulent gas jets in liquids
| AD-A197939 | N89-14396
Experimental correlation of melt structures, nucleation rates, and thermal histories of silicate melts N89-15044
**LITHOGRAPHY**
Block interrupt polysilane derivatives
| AD-A198804 | N89-14312
**LITHOSPHERE**
Heat flow and magnetization in the oceanic lithosphere
| NASA-CR-183346 | N89-14653
**LOAD TESTS**
Fatigue evolution of small two and three dimensional cracks under variable and constant amplitude loading
| MM-AL/AP-04-88 | N89-14471
**LOADS (FORCES)**
Analysis of shell-type structures subjected to time-dependent mechanical and thermal loading
| NASA-CR-183005 | N89-14457
Fatigue evolution of small two and three dimensional cracks under variable and constant amplitude loading
| MM-AL/AP-04-88 | N89-14471
**LOCAL AREA NETWORKS**
Spacelab system analysis: A study of communications systems for advanced launch systems
| NASA-CR-183515 | N89-14248
Spacelab system analysis: A study of the Marshall Avionics System Testbed (MAST)
| NASA-CR-183516 | N89-14354
**LOGISTICS**
Processor and data bus interface analyses
| AD-A198801 | N89-14696
**LONG TERM EFFECTS**
The influence of grazing on land surface climatological variables
| NASA-CR-183308 | N89-14637
**LOSSES**
The effect of parasitic absorption losses on light trapping in thin silicon solar cells
| DE89-000457 | N89-14501
**LOW ALTITUDE**
Quantitative observations of the behavior of anomalous low altitude ClO in the Antarctic spring Stratosphere, 1987 N89-14548
**LOW PRESSURE**
Monochromatic imaging studies of a low pressure arc burning on molten Inconel 718 alloy electrodes during vacuum arc remelting
| DE88-012855 | N89-14292
**LOW REYNOLDS NUMBER**
Two-equation low-Reynolds-number turbulence modeling of transitional boundary layer flows characteristic of gas turbine blades N89-14218
**LOW TEMPERATURE**
Laboratory studies of HNO3/H2O mixtures at low temperatures N89-14533
Stability and photochemistry of ClO dimers formed at low temperature in the gas phase N89-14600
Chemistry of the CO dimer at low temperatures N89-14602
**LOWER ATMOSPHERE**
Springtime surface ozone fluctuations at high Arctic latitudes and their possible relationship to atmospheric bromine N89-14581
Scientific evaluation and assessment of ASL developed moist atmosphere models for low stratus subclouds
| AD-A198762 | N89-14625
**LUBRICANTS**
An investigation into fluid film lubrication in dynamically loaded bearings N89-14442
The role of thermal and lubricant boundary layers in the transient thermal analysis of spur gears
| NASA-TM-101435 | N89-14452
**LUBRICATION SYSTEMS**
The role of thermoelastic effects in the scuffing failure of rolling/sliding EHD contacts
| AD-A198475 | N89-14447
**LUMINOUS INTENSITY**
The nature of luminous IRAS galaxies N89-15053
**LUNAR BASES**
Lunar hydrogen: A resource for future use at lunar bases and space activities N89-14847
Synergism of He-3 acquisition with lunar base evolution N89-14852
**LUNAR EXPLORATION**
Investigation of the enhanced spatial density of submicron lunar ejecta between L values 1.2 and 3.0 in the earth's magnetosphere: Theory N89-15007
**LUNAR GEOLOGY**
Economic geology of lunar Helium-3 N89-14849
**LUNAR MARIA**
Economic geology of lunar Helium-3 N89-14849
Mining for helium: Site selection and evaluation N89-14850
**LUNAR SOIL**
Lunar Helium-3 and Fusion Power
| NASA-CP-10018 | N89-14842
The moon: An abundant source of clean and safe fusion fuel for the 21st century N89-14843
Lunar hydrogen: A resource for future use at lunar bases and space activities N89-14847
Processes and energy costs for mining lunar Helium-3 N89-14848
Economic geology of lunar Helium-3 N89-14849
Mining for helium: Site selection and evaluation N89-14850
Assessment of lunar sources of He-3 for use on earth N89-14853
**LUNGS**
Progress in lung modeling by the ICRP task group
| DE88-015934 | N89-14671
**LUTETIUM**
Preparation, structure, and spectroscopic properties of nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 crystals
| AD-A198476 | N89-14883

## M

**MACH NUMBER**
Optimization of slender wings for center-of-pressure shift due to change in Mach number N89-14897
**MAGMA**
Textural evolution of partially-molten planetary materials in microgravity N89-15037
**MAGNETIC DIFFUSION**
Transient magnetohydrodynamic liquid-metal flows in a rectangular channel with a moving conducting wall
| AD-A197308 | N89-14841
**MAGNETIC FIELD CONFIGURATIONS**
Nonlinear magnetic reconnection N89-15052
**MAGNETIC FIELD RECONNECTION**
Nonlinear magnetic reconnection N89-15052
**MAGNETIC FIELDS**
Transverse effects of a waveguide coupling slot
| DE89-000340 | N89-14356
Magnetic and electric field meters developed for the US Department of Energy
| NASA-CR-184628 | N89-14421
The electron laser facility: A millimeter wave free-electron laser amplifier
| DE88-016118 | N89-14436
Technology and physics implications of oscillating-field current drive in reversed-field pinches
| DE89-000388 | N89-14861
Josephson junction arrays with positional disorder: Experiments and simulations N89-14867
Magnetic field penetration into the high temperature superconductor YBa2Cu3O(sub 7-x)
| DE89-000547 | N89-14873
Modified soldered joints of current-carrying superconductors
| DE88-703754 | N89-14878
Offset reduction and three dimensional field sensing with magnetotransistors
| ETN-89-93349 | N89-14890
Magnetic properties of C 4 Doppler shift patterns
| AD-A198602 | N89-15062
**MAGNETIC MEASUREMENT**
Magnetic and electric field meters developed for the US Department of Energy
| NASA-CR-184628 | N89-14421
Offset reduction and three dimensional field sensing with magnetotransistors
| ETN-89-93349 | N89-14890
**MAGNETIC POLES**
Magnetic properties of C 4 Doppler shift patterns
| AD-A198602 | N89-15062
**MAGNETIC RESONANCE**
Perceptual factors in workload: A neuromagnetic study
| AD-A198487 | N89-14681
**MAGNETIC STARS**
Disk accretion onto weakly magnetized neutron stars N89-15057
**MAGNETIC SUSPENSION**
The 13-inch magnetic suspension and balance system wind tunnel
| NASA-TM-4090 | N89-14241
**MAGNETIC TAPES**
User's guide for the Nimbus 7 Scanning Multichannel Microwave Radiometer (SMMR) CELL-ALL tape
| NASA-RP-1210 | N89-14648
On 3480 class tape cartridge drives and archival data storage: Technology assessment report
| PB88-233135 | N89-14939
**MAGNETIZATION**
Heat flow and magnetization in the oceanic lithosphere
| NASA-CR-183346 | N89-14653
**MAGNETOHYDRODYNAMIC FLOW**
Transient magnetohydrodynamic liquid-metal flows in a rectangular channel with a moving conducting wall
| AD-A197308 | N89-14841
**MAGNETOHYDRODYNAMICS**
Activities report in plasma physics
| ETN-89-93377 | N89-14864
**MAGNETORESISTIVITY**
Josephson junction arrays with positional disorder: Experiments and simulations N89-14867
**MAGNETOSPHERES**
TIROS/NOAA (television and infrared observation satellite/National Oceanic and Atmospheric Administration) satellites space environment monitor archive tape documentation, 1988 update
| PB88-224613 | N89-14619
Analysis of ISEE-3/ICE solar wind data
| NASA-CR-184652 | N89-15063
**MAGNETOSTRICTION**
Light weight high performance manipulators
| AD-A198647 | N89-14448
**MAGNONS**
Nuclear spin cooling using antiferromagnetic magnons N89-14822
**MAIN SEQUENCE STARS**
Studies of the interstellar medium in the inner galaxy at 21 centimeters N89-15055
**MAINTAINABILITY**
Evaluation of the improved OV-1D anti-icing system
| AD-A198438 | N89-14225
**MAINTENANCE**
The FIS electronics troubleshooting system N89-14742
Expert Missile Maintenance Aid (EMMA): An application of artificial intelligence technology to the munition maintenance domain N89-14748
CEPS: An artificial intelligence approach to avionics maintenance N89-14749
Artificial intelligence technology for the maintainer's associate N89-14752
A maintenance and diagnostic information system N89-14754
Avionics fault tree analysis and artificial intelligence for future aircraft maintenance N89-14760
System integration of knowledge-based maintenance aids N89-14768
**MAN-COMPUTER INTERFACE**
Man-robot symbiosis: A framework for cooperative intelligence and control
| DE89-000430 | N89-14687
Computation via direct manipulation
| AD-A198417 | N89-14690
Transportable educational programs for scientific and technical professionals: More effective utilization of automated scientific and technical data base systems
| NASA-CR-184507 | N89-14947
The man/machine interface in information retrieval: Providing access to the casual user
| NASA-CR-184512 | N89-14952
KARL: A Knowledge-Assisted Retrieval Language. Presentation visuals
| NASA-CR-184530 | N89-14970
A methodology for the design and evaluation of user interfaces for interactive information systems
| NASA-CR-184532 | N89-14972
The USL NASA PC R and D development environment standards
| NASA-CR-184535 | N89-14975
The USL NASA PC R and D project: Detailed specifications of objects
| NASA-CR-184540 | N89-14980

Design criteria for a PC-based common user interface to-remote information systems
[NASA-CR-184541] N89-14981
IBM PC/IX operating system evaluation plan
[NASA-CR-184546] N89-14986
PC-based Multiple Information System Interface (PC/MISI) design plan
[NASA-CR-184547] N89-14987
PC-based Multiple Information System Interface (PC/MISI) detailed design and implementation plan
[NASA-CR-184548] N89-14988
An overview of the evaluation plan for PC/MISI: PC-based Multiple Information System Interface
[NASA-CR-184549] N89-14989

**MANAGEMENT**
DEH (Directorates of Engineering and Housing) automated graphics guide: Selection, acquisition, implementation, and management
[AD-A198489] N89-14721

**MANAGEMENT INFORMATION SYSTEMS**
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems. Presentation visuals
[NASA-CR-184524] N89-14964

**MANGANESE ALLOYS**
Analysis of ductile-brittle transition temperatures for controlled-rolled, microalloyed, C-Mn-based steels
[AD-A198132] N89-14298

**MANIPULATORS**
Light weight high performance manipulators
[AD-A198647] N89-14448
The effect of transmission design on force-controlled manipulator performance
[AD-A198131] N89-14689
A general expression of Jacobian matrix and its simplified computation method: Relationships between the velocities of manipulator hand and joints
[DE88-754808] N89-14782

**MANNED SPACE FLIGHT**
Eye and head motion during head turns in spaceflight
[NASA-TM-100466] N89-14676
Curriculum in aerospace science and technology in cooperation with NASA Langley Research Center N89-14908
Preliminary estimates of galactic cosmic ray shielding requirements for manned interplanetary missions
[NASA-TM-101516] N89-15070

**MANUFACTURING**
Ceramics: Materials for severe environments
[PB88-240049] N89-14308
A fast ion beam pattern generator
[ETN-89-93354] N89-14350

**MAPPING**
Plotting component maps in the Navy/NASA Engine Program (NNEP): A method and its usage
[NASA-TM-101433] N89-14239
Geologic mapping in the US Geological Survey
[PB88-223870] N89-14477
Variations of total ozone in the north polar region as seen by TOMS N89-14571
Heat flow and magnetization in the oceanic lithosphere
[NASA-CR-183346] N89-14653
Computation via direct manipulation
[AD-A198417] N89-14690
Optical inference machines
[AD-A197880] N89-14772
Some issues in data model mapping
[NASA-CR-184528] N89-14968
Mapping experiment with space station N89-15046

**MARINE BIOLOGY**
Chemical variability in ocean frontal areas
[AD-A198418] N89-14655

**MARINE CHEMISTRY**
Chemical variability in ocean frontal areas
[AD-A198418] N89-14655

**MARINE ENVIRONMENTS**
Aerosol characteristics in the Marine Boundary Layer over the Straits of Gibraltar, June 1986
[AD-A197945] N89-14642

**MARINE METEOROLOGY**
Optical and infrared properties of the marine atmosphere, phase 1
[FEL-1987-76] N89-14630
Aerosol characteristics in the Marine Boundary Layer over the Straits of Gibraltar, June 1986
[AD-A197945] N89-14642

**MARINE RESOURCES**
Statistical model of environmental contaminants using variance spectrum analysis
[PB88-235130] N89-14615

**MARS ATMOSPHERE**
Scientific results of the NASA-sponsored study project on Mars: Evolution of its climate and atmosphere
[NASA-TM-101207] N89-15059

**MARTENSITIC STAINLESS STEELS**
Analysis of hydrogen diffusion and trapping in a 13 percent chromium martensitic stainless steel
[NPL-DMA(A)-158] N89-14301

**MASS**
An intercomparison of the radium mass standards of the UK and the USSR
[NPL-RS(EXT)-103] N89-14828

**MASS DISTRIBUTION**
How to make a comet N89-15035
New techniques for the detection and capture of micrometeoroids N89-15041

**MASS FLOW**
Crystal growth of CdTe in space and thermal field effects on mass flux and morphology
[NASA-CR-183263] N89-14868

**MASS SPECTROSCOPY**
Reactions of metal ions and their clusters in the gas phase using laser ionization-Fourier transform mass spectrometry
[DE88-017281] N89-14431

**MASS TRANSFER**
Measurement and prediction of mass transfer in solid catalysts N89-14267
Aerodynamic and kinetic processes in flames
[AD-A198474] N89-14284
Mass accommodation coefficient measurements for HNO3, HCl and N2O5 on water, ice and aqueous sulfuric acid droplet surfaces N89-14538
Comparison of the poleward transport of ozone in the Northern and Southern Hemispheres N89-14591

**MATERIAL ABSORPTION**
Progress in lung modeling by the ICRP task group
[DE88-015934] N89-14671

**MATHEMATICAL MODELS**
Turbofan forced mixer lobe flow modeling. 1: Experimental and analytical assessment
[NASA-CR-4147-PT-1] N89-14221
Turbofan forced mixer lobe flow modeling. 2: Three-dimensional inviscid mixer analysis (FLOMIX)
[NASA-CR-4147-PT-2] N89-14222
Calculation of the steadily periodic and gust responses of a hingeless rotor helicopter using two-dimensional time domain unsteady aerodynamics N89-14240
A viscoplastic constitutive model for anisotropic metals at high temperature N89-14305
A numerical simulation of the flow field and heat transfer in a rectangular passage with a turbulence promoter
[AD-A198579] N89-14400
Light weight high performance manipulators
[AD-A198647] N89-14448
A unified model for predicting the stress and strain distributions around cracks of any length, including elastic, plastic, creep and cyclic deformation N89-14455
Temperature effect on stress concentration around circular hole in a composite material specimen representative of X-29A forward-swept wing aircraft
[NASA-CR-179439] N89-14456
Parametric studies of advanced turboprops
[NASA-TM-101389] N89-14465
On the connection of digitized maps to a uniform coordinate system. A special case of the geodetic connection problem
[B8821602] N89-14487
Homogeneous plate deformation as monitored by Satellite Laser Ranging (SLR) and analyzed using 3D affine transformation models
[B8821604] N89-14488
The use of short range stereophotogrammetry for facial asymmetry and growth studies; analysis and model
[B8821611] N89-14491
Physical processes in polar stratospheric ice clouds N89-14536
Polar vortex dynamics N89-14588
A two-dimensional model of the quasi biennial oscillation of ozone N89-14596
A microcomputer pollution model for civilian airports and air force bases, model description
[AD-A199003] N89-14616
Determination of soil moisture beneath a stalk or trunk dominated canopy
[NASA-CR-183322] N89-14621
Semi-prognostic tests of cumulus parameterization schemes in the middle latitudes
[PB88-236013] N89-14639
Implicit normal-mode initialization of the PSU/NCAR (Pennsylvania State University/National Center for Atmospheric Research) mesoscale model
[PB88-126021] N89-14640
Numerical atmospheric models
[KNMI-TR-107] N89-14649
Progress in lung modeling by the ICRP task group
[DE88-015934] N89-14671
A split-Levinson approach to autoregressive modeling
[AD-A198535] N89-14722
Research instrumentation for computer vision, image understanding and optical computing
[AD-A198578] N89-14723
Numerical simulation of injection molding: Non-isothermal non-Newtonian flow of polymers in complex geometries
[ETN-89-93348] N89-14727
Queuing network models and performance analysis of computer systems
[B8811769] N89-14738
Summaries of the FY86 applied mathematical sciences research program
[DE89-000242] N89-14784
Numerical optimization
[AD-A198586] N89-14793
Universal limiter for transient interpolation modeling of the advective transport equations: The ULTIMATE conservative difference scheme
[NASA-TM-100916] N89-14794
Study of the discrete models of the Boltzmann equation
[DRET-86-1507/DS/SR] N89-14797
Evolution of photon and particle spectra in compact, luminous objects
[NASA-TM-101247] N89-14825
Modeling of RF plasmas in a parallel plate etch reactor
[B8811775] N89-14865
Application of linear response theory to experimental data of simultaneous radiation and annealing response of a CMOS device
[NASA-CR-183401] N89-14871
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899
An investigation of turbulence models N89-14905
Computer modeling of polymers N89-14910
Modeling of transitional flows N89-14917
Extension and validation of a method for locating damaged members in large space trusses N89-14925
Grain dynamics in zero gravity N89-15038
Nonlinear magnetic reconnection N89-15052

**MATRICES (MATHEMATICS)**
Ordering methods for sparse matrices and vector computers
[AD-A198291] N89-14717
A general expression of Jacobian matrix and its simplified computation method: Relationships between the velocities of manipulator hand and joints
[DE88-754808] N89-14782
Analogs of Clifford algebra for forms above quadratic and their matrix realization
[DE88-703748] N89-14787
Generalized Eigenvalues for pairs on heritian matrices N89-14923

**MATRIX METHODS**
Efficient load measurements using singular value decomposition
[NASA-CR-184614] N89-14795

**MATRIX THEORY**
The CSM testbed matrix processors internal logic and dataflow descriptions
[NASA-CR-181742] N89-14474

**MATTER (PHYSICS)**
Subpicosecond, high-brightness excimer laser systems
[DE88-016239] N89-14430
On a solution of the Einstein gravitation equation for dust matter
[DE88-703739] N89-14893

**MAXIMUM LIKELIHOOD ESTIMATES**
Robustness of marginal maximum likelihood estimation in the Rasch model
[PB88-209374] N89-14801

**MEASURING INSTRUMENTS**
The meteorological measurement system on the NASA ER-2 aircraft N89-14562

**MECHANICAL DEVICES**
System for the optimum design of structures
[ETN-89-93599] N89-14451

**MECHANICAL DRIVES**
On 3480 class tape cartridge drives and archival data storage: Technology assessment report
[PB88-233135] N89-14939

**MECHANICAL PROPERTIES**
Mechanical property enhancement in ceramic matrix composites
[PB88-232863] N89-14257
Mechanical properties of dispersion strengthened copper: A comparison of braze cycle annealed and coarse grain microstructures
[DE89-001061] N89-14296
Ceramics: Materials for severe environments
[PB88-240049] N89-14308
Study of high temperature failure mechanisms in ceramics
[AD-A198375] N89-14324

Polyphenylquinoxalines containing alkylenedioxy groups
[NASA-CASE-LAR-13601-1-CU] N89-14337
The effect of transmission design on force-controlled manipulator performance
[AD-A198131] N89-14689
Simulation studies for surfaces and materials strength
[NASA-CR-183378] N89-14824
Preparation, structure, and spectroscopic properties of nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 crystals
[AD-A198476] N89-14883

**MECHANICAL SHOCK**
GREEDI: The computerization of the DOE/DOD environmental data bank
[DE88-014965] N89-14941

**MEDICAL EQUIPMENT**
Cardiovascular system and space environment
[ETN-89-93600] N89-14674

**MEDITERRANEAN SEA**
Make-map and MEDMAP: Two programs for plotting maps of the Mediterranean Sea
[AD-A198491] N89-14483
Aerosol characteristics in the Marine Boundary Layer over the Straits of Gibraltar, June 1986
[AD-A197945] N89-14642

**MELTS (CRYSTAL GROWTH)**
Kinetics of mineral condensation in the solar nebula N89-15019
Dynamic crystallization experiments on chondrule melts in reduced gravity N89-15023
Textural evolution of partially-molten planetary materials in microgravity N89-15037
Experimental correlation of melt structures, nucleation rates, and thermal histories of silicate melts N89-15044

**MEMORY (COMPUTERS)**
ELEFUNT test results under FORTRAN-PLUS on the active memory technology DAP 510-8
[DE88-017264] N89-14700

**MENTAL PERFORMANCE**
Mental models for time displayed tasks
[AD-A198536] N89-14682

**MERCURY CADMIUM TELLURIDES**
Hg,CdTe material optimization for carrier lifetime maximization
[AD-A198101] N89-14880

**MERCURY TELLURIDES**
Ternary solid phase equilibria in the systems (Ag,In,Au)-(Cd,He)-Te
[AD-A198679] N89-14302

**MESH**
Improvement in finite element meshes: Heat transfer in an infinite cylinder
[NASA-TM-101410] N89-14450

**MESOSCALE PHENOMENA**
Implicit normal-mode initialization of the PSU/NCAR (Pennsylvania State University/National Center for Atmospheric Research) mesoscale model
[PB88-126021] N89-14640

**MESOSPHERE**
Investigations of the dynamics and thermodynamics of the mesosphere and upper thermosphere at the polar regions
[AD-A198463] N89-14627

**MESSAGE PROCESSING**
Random access algorithms for multiuser computer communication networks
[AD-A198090] N89-14713

**METABOLISM**
Influence of high temperature on total gas metabolism of animals with limitation of motor activity N89-14661
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
[AD-A197472] N89-14668

**METAL MATRIX COMPOSITES**
The viscoplastic behavior of SCS6/Ti-15-3 metal matrix composite materials at elevated temperatures N89-14929

**METAL OXIDE SEMICONDUCTORS**
Parallel processing techniques for the simulation of MOS VLSI circuits using waveform relaxation
[AD-A197879] N89-14734

**METAL SURFACES**
Implantation studies of hydrogen by field ion microscopy and spectroscopy
[DE88-016020] N89-14293

**METAL-METAL BONDING**
Characterization study of the structural bonding system EA 9680 (EA 9645). Test report 1/R/86
[REPT-1/R/86] N89-14334
Metal-metal bonding: Contribution to the study of aging. Test report 48-453/F
[REPT-48-453/F] N89-14335

**METALLIC PLASMAS**
The future of intelligent spectrometers in metal speciation by atomic emission spectrometry
[AD-A198592] N89-14287

**METALS**
A new method for trace metal determinations by monitoring modulated magnetically induced optical rotation in atomic vapours
[AD-A198799] N89-14272

**METASTABLE STATE**
Thermal analysis system (DSC, TGA, TMA) for oxidation and phase transformation studies of alloys with mestable phase
[AD-A198420] N89-14415

**METEORITES**
Electrical conductivity of carbonaceous chondrites and electric heating of meteorite parent bodies N89-15011
Ultraviolet spectroscopy of meteoric debris: In situ calibration experiments from earth orbit N89-15031

**METEORITIC COMPOSITION**
Volatilization-fractionation of silicates related to chondrite composition N89-15036

**METEOROLOGICAL INSTRUMENTS**
The data collection component of the Hanford Meteorology Monitoring Program
[DE89-000404] N89-14641

**METEOROLOGICAL PARAMETERS**
The meteorological measurement system on the NASA ER-2 aircraft N89-14562
Climatology of the Melbourne University general circulation model
[PB88-227491] N89-14638

**METEOROLOGICAL SATELLITES**
Possible measurement errors in calibrated AVHRR (Advanced Very High Resolution Radiometer) data
[AD-A198342] N89-14414

**METEOROLOGY**
The data collection component of the Hanford Meteorology Monitoring Program
[DE89-000404] N89-14641

**METEOSAT SATELLITE**
Fitting of Meteosat information into meteorological decision making
[KNMI-TR-108] N89-14650

**METHANE**
Stratospheric feedback from continued increases in tropospheric methane N89-14606

**METHODOLOGY**
A review of failure models for unidirectional ceramic matrix composites under monotonic loads
[NASA-TM-101421] N89-14470

**METROLOGY**
Development of an endoscopic probe for radial metrology
[NASA-CR-184577] N89-14417
The precise determination of the refractive index of air
[NPL-MOM-90] N89-14629

**MICROBURSTS (METEOROLOGY)**
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
[NASA-CR-181724] N89-14896
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899

**MICROCOMPUTERS**
A preliminary report on developing an expert system for computer-aided formulation of propellants
[AD-A198088] N89-14339
A microcomputer pollution model for civilian airports and air force bases, model description
[AD-A199003] N89-14616
Development and demonstration of Microcomputer Intelligence for Technical Training (MITT)
[AD-A197971] N89-14775
Design criteria for a PC-based common user interface to remote information systems
[NASA-CR-184541] N89-14981

**MICROELECTRONICS**
Development of a microcircuit grid technique for automated crack length measurement for fatigue testing at elevated temperature
[AD-A198003] N89-14463

**MICROMETEORITES**
A planetary ultra hypervelocity impact mechanics and shock wave science facility N89-15005

**MICROMETEOROIDS**
New techniques for the detection and capture of micrometeoroids N89-15041

**MICROPROCESSORS**
Spacelab system analysis: A study of the Marshall Avionics System Testbed (MAST)
[NASA-CR-183516] N89-14354
Running a large Monte Carlo Program in a farm of MicroVAX-II computers under VAXELIN
[DE88-012761] N89-14732

**MICROSCOPY**
Implantation studies of hydrogen by field ion microscopy and spectroscopy
[DE88-016020] N89-14293
Progress and prospects in soft X-ray holographic microscopy
[DE88-016638] N89-14409

**MICROSTRIP ANTENNAS**
A user's manual for the Loaded Microstrip Antenna Code (LMAC)
[NASA-CR-184596] N89-14725

**MICROSTRUCTURE**
Mechanical properties of dispersion strengthened copper: A comparison of braze cycle annealed and coarse grain microstructures
[DE89-001061] N89-14296
Bi-Ca-Sr-Cu-O superconductors: The connectivity issue
[DE89-000558] N89-14874

**MICROWAVE EQUIPMENT**
High-power microwave source development at Los Alamos
[DE89-000327] N89-14830

**MICROWAVE OSCILLATORS**
Investigation of a new concept in semiconductor microwave oscillators
[AD-A198039] N89-14380

**MICROWAVE RADIOMETERS**
User's guide for the Nimbus 7 Scanning Multichannel Microwave Radiometer (SMMR) CELL-ALL tape
[NASA-RP-1210] N89-14648

**MICROWAVE SCATTERING**
Specular reflection coefficient of snow at 10, 35 and 94 GHz as a function of grazing angle (Oberjettenberg-Campaign)
[FEL-1988-01] N89-14495

**MICROWAVE TRANSMISSION**
Observational results of microwave temperature profile measurements from the airborne Antarctic ozone experiment N89-14558

**MICROWAVES**
Detection of ions by replacement-ion chromatography coupled to a microwave-induced nitrogen discharge at atmospheric pressure
[AD-A198800] N89-14273
Evaluation of microwave anechoic chamber absorbing materials
[AD-A198055] N89-14320
High-power microwave source development at Los Alamos
[DE89-000327] N89-14830

**MILITARY AIR FACILITIES**
A microcomputer pollution model for civilian airports and air force bases, model description
[AD-A199003] N89-14616

**MILITARY OPERATIONS**
STU-3 system level description and network applications, revision
[AD-A198514] N89-14363
Reconfigurable flight control: An opportunity for integrated diagnostics N89-14744

**MILITARY TECHNOLOGY**
Hg,CdTe material optimization for carrier lifetime maximization
[AD-A198101] N89-14880

**MINERAL EXPLORATION**
Geologic mapping in the US Geological Survey
[PB88-223870] N89-14477

**MINERALS**
Kinetics of mineral condensation in the solar nebula N89-15019

**MINING**
Lunar Helium-3 and Fusion Power
[NASA-CP-10018] N89-14842
Processes and energy costs for mining lunar Helium-3 N89-14848
Mining for helium: Site selection and evaluation N89-14850
Synergism of He-3 acquisition with lunar base evolution N89-14852
Assessment of lunar sources of He-3 for use on earth N89-14853

**MIR SPACE STATION**
Current achievements in cosmonautics
[NASA-TT-20365] N89-14245

**MIRRORS**
Experiments with three identical ultraprecision machine tools
[DE88-016324] N89-14445

**MISSILE DEFENSE**
SDI (Strategic Defense Initiative): Technology, survivability and software
[PB88-236245] N89-14811

**MISSILES**
Expert Missile Maintenance Aid (EMMA): An application of artificial intelligence technology to the munition maintenance domain N89-14748
**MISSION PLANNING**
Comparison of the general dynamics ground clobber algorithm with the GCAS and laws algorithms [AD-A198479] N89-14226
**MIXING**
Dynamic combustion studies using advanced optical diagnostics. Volume 2: Tabulated data [AD-A198025] N89-14281
Stratospheric feedback from continued increases in tropospheric methane N89-14606
**MIXING LAYERS (FLUIDS)**
Turbofan forced mixer lobe flow modeling. 1: Experimental and analytical assessment [NASA-CR-4147-PT-1] N89-14221
Turbofan forced mixer lobe flow modeling. 2: Three-dimensional inviscid mixer analysis (FLOMIX) [NASA-CR-4147-PT-2] N89-14222
Effect of heat release on the spatial stability of a supersonic reacting mixing layer [NASA-CR-181753] N89-14402
**MIXTURES**
Rheological studies on blends of rodlike and flexible chain polymers [AD-A198455] N89-14326
Semi-interpenetrating polymer network's of polyimides: Fracture toughness N89-14912
**MODELS**
The influence of porosity on short fatigue crack growth at large strain amplitudes [AD-A198477] N89-14464
Photochemical trajectory modelling studies of the 1987 Antarctic spring vortex N89-14559
Photochemical modeling of the Antarctic stratosphere: Observational constraints from the airborne Antarctic ozone experiment and implications for ozone behavior N89-14569
Statistical model of environmental contaminants using variance spectrum analysis [PB88-235130] N89-14615
Spacing effects in learning described by the SAM model. Comparing three versions of the SAM model [PB88-204060] N89-14678
The integrated diagnostic model: Towards a second generation diagnostic expert system N89-14747
Robustness of marginal maximum likelihood estimation in the Rasch model [PB88-209374] N89-14801
A note on second order effects in a semiparametric context [AD-A198018] N89-14804
The use of think aloud verbal protocols for the identification of mental models [DE88-015180] N89-14935
Some issues in data model mapping [NASA-CR-184528] N89-14968
**MODULARITY**
A 3-D object recognition system using aspect graphs [AD-A198472] N89-14720
**MODULATION**
A concatenated coded modulation scheme for error control (addition 2) [NASA-CR-183260] N89-14706
Acoustic phonon scattering in modulation doped Aluminum (subx) Gallium (sub 1x) Arsenide/Gallium arsenide heterojunctions [AD-A198512] N89-14885
**MODULES**
Ordering methods for sparse matrices and vector computers [AD-A198291] N89-14717
**MOISTURE CONTENT**
Scientific evaluation and assessment of ASL developed moist atmosphere models for low stratus subclouds [AD-A198762] N89-14625
Scientific results of the NASA-sponsored study project on Mars: Evolution of its climate and atmosphere [NASA-TM-101207] N89-15059
**MOLECULAR ABSORPTION**
Retrieval of atmospheric temperatures and gas volume mixing ratios and column amounts from infrared solar absorption spectra [PB88-236153] N89-14622
**MOLECULAR BEAM EPITAXY**
New MBE buffer for micron- and quarter-micron-gateGaAs MESFETs N89-14346
Photonic applications of thin film GaAs grown on silicon and insulating substrates by molecular beam epitaxy [DE88-016975] N89-14877
**MOLECULAR BEAMS**
Molecular beam studies of surface phonons and gas surface interactions [AD-A198435] N89-14826
**MOLECULAR GASES**
The detection and study of molecular species using time resolved laser spectroscopy [AD-A198482] N89-14285
**MOLECULAR INTERACTIONS**
Collision phenomena in a quantum gas [B8811778] N89-14829
**MOLECULAR SPECTROSCOPY**
Molecular spectroscopy using charge transfer device detectors [AD-A198593] N89-14288
**MOLECULAR STRUCTURE**
Variable temperature solid state NMR of side-chain crystalline comb polymers [AD-A198099] N89-14322
The synthesis and structure of polyphosphazenes [AD-A198519] N89-14329
**MOLECULES**
The detection and study of molecular species using time resolved laser spectroscopy [AD-A198482] N89-14285
Macromolecular calculations in the XTAL system of crystallographic programs [AD-A198525] N89-14886
Computer modeling of polymers N89-14910
**MOMENTUM**
Small linear wind tunnel saltation experiments: Some experiences N89-15015
**MOMENTUM TRANSFER**
Application of Fabry-Perot velocimeter to high-speed experiments [DE88-016269] N89-14410
**MONATOMIC GASES**
Investigation of the hydrogen source for masers [PB88-225685] N89-14424
**MONITORS**
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic N89-14577
**MONOMERS**
Block interrupt polysilane derivatives [AD-A198804] N89-14312
The synthesis of carborane-oxetane monomers and their polymerization [AD-A198596] N89-14330
Polyphenylquinoxalines containing alkylenedioxy groups [NASA-CASE-LAR-13601-1-CU] N89-14337
**MONTE CARLO METHOD**
Constitutive relations for rapidly sheared granular flows: A Monte Carlo form based on the kinetic theory of dense gases N89-14387
Dynamics of unbound vortices in the 2-dimensional XY and anisotropic Heisenberg models [DE89-000371] N89-14394
Running a large Monte Carlo Program in a farm of MicroVAX-II computers under VAXELIN [DE88-012761] N89-14732
**MOON**
Total ozone by lunar Dobson observation at Syowa, Antarctica N89-14504
**MORPHOLOGY**
The threee-dimensional morphology of the Antarctic ozone hole N89-14509
The morphology and meteorology of Southern Hemisphere spring total ozone mini-holes N89-14516
Progress in lung modeling by the ICRP task group [DE88-015934] N89-14671
Methods of analysis of coupled spin-lattice relaxations and spin diffusion in heterogeneous organic solids with application to keratin N89-14823
Crystal growth of CdTe in space and thermal field effects on mass flux and morphology [NASA-CR-183263] N89-14868
Nucleation and particle coagulation experiments in microgravity N89-15030
**MOTION SIMULATORS**
Articulated total body model enhancements. Volume 3: Programmer's guide [AD-A197940] N89-14688
**MULTIPATH TRANSMISSION**
Precision approach radars Twenthe and Volkel (Netherlands). Multipath propagation problems [FEL-1988-15] N89-14372
**MULTIPHASE FLOW**
Underexpanded noncondensing turbulent gas jets in liquids [AD-A197939] N89-14396
**MULTIPLE ACCESS**
Random access algorithms for multiuser computer communication networks [AD-A198090] N89-14713
**MULTIPLEXING**
Chemical and Laser Sciences Division [DE88-017140] N89-14274
Laser Doppler velocimeter multiplexer interface for simultaneous measured events [NASA-CASE-ARC-11536-1] N89-14384
High speed data acquisition systems [AD-A198194] N89-14735
**MULTIPROCESSING (COMPUTERS)**
Numerical optimization [AD-A198586] N89-14793
**MULTISPECTRAL BAND SCANNERS**
Automatic procedure to find corresponding points in CCD Airborne Experimental Scanner for Applications in Remote sensing (CAESAR) images [B8821609] N89-14490
User's guide for the Nimbus 7 Scanning Multichannel Microwave Radiometer (SMMR) CELL-ALL tape [NASA-RP-1210] N89-14648
**MULTIVARIATE STATISTICAL ANALYSIS**
Simplifying complex QSAR's (Quantitative Structure-Activity Relationships) in toxicity studies with multivariate statistics [PB88-233937] N89-14614
Estimation of parameters and the goodness-of-fit test for multivariate distributions for data presented as one-dimensional histograms [DE88-703697] N89-14803
**MUSCLES**
Holographic recording of deformation waves in muscle tissue N89-14660
**MUSCULAR FUNCTION**
Functional significance and mechanisms of variability in baroreceptor reflex N89-14664
**MYLAR (TRADEMARK)**
Radiation effects on polymeric materials N89-14914
**MYOCARDIUM**
Influence of emotional-pain stress on contractile function of myocardium during long-term hypokinesia N89-14662

## N

**NACELLES**
Fire extinguishing agent evaluation in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS) [AD-A198523] N89-14227
**NASA PROGRAMS**
Curriculum in aerospace science and technology in cooperation with NASA Langley Research Center N89-14908
Welcome to Ames Research Center (1987 forum on Federal technology transfer) [NASA-TM-100088] N89-14995
Microgravity research in NASA ground-based facilities [NASA-TM-101397] N89-15047
**NATURAL LANGUAGE (COMPUTERS)**
Concepts and implementations of natural language query systems [NASA-CR-184514] N89-14954
Natural language query system design for interactive information storage and retrieval systems [NASA-CR-184525] N89-14965
Natural language query system design for interactive information storage and retrieval systems. Presentation visuals [NASA-CR-184526] N89-14966
KARL: A Knowledge-Assisted Retrieval Language [NASA-CR-184529] N89-14969
KARL: A Knowledge-Assisted Retrieval Language. Presentation visuals [NASA-CR-184530] N89-14970
**NAVIER-STOKES EQUATION**
Numerical analysis of flow through oscillating cascade sections [NASA-TM-101417] N89-14220
Coupled three-dimensional conduction and natural convection heat transfer N89-14388
Dynamic stall computations using a zonal Navier-Stokes model [AD-A197942] N89-14397
Navier-Stokes calculations of transonic flows past cavities [NASA-CR-4210] N89-14401
Single-grid spectral collocation for the Navier-Stokes equations [NASA-CR-181754] N89-14799
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight [NASA-CR-4212] N89-14821
Numerical methods for turbulent flow N89-14928
**NAVIGATION AIDS**
Autonomous RPRV navigation, guidance and control [NASA-CR-179425] N89-14228

**NAVY**
Human factors in the Naval Air Systems Command: Computer based training
| DE88-015301 | N89-14686
**NEAR ULTRAVIOLET RADIATION**
Visible and near-ultraviolet spectroscopy at Thule AFB (76.5 N) from January 28 - February 15, 1988
N89-14576
**NEBULAE**
Kinetics of mineral condensation in the solar nebula
N89-15019
Kinetics in a turbulent nebular cloud N89-15025
**NEODYMIUM**
Preparation, structure, and spectroscopic properties of nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 crystals
| AD-A198476 | N89-14883
**NETHERLANDS**
Geomagnetic survey of the Netherlands, reduced to 1985
| KNMI-TR-109 | N89-14632
**NETWORK ANALYSIS**
On the connection of digitized maps to a uniform coordinate system. A special case of the geodetic connection problem
| B8821602 | N89-14487
**NETWORK CONTROL**
Network management of highly adaptive communication networks
| AD-A198429 | N89-14362
**NETWORKS**
Description of the network method and the simulation package simulation based on networks (SIMONE)
| IWECO-5176814-87-1 | N89-14730
**NEURAL NETS**
Circuit behavior in the development of neuronal networks
| AD-A198040 | N89-14672
Research instrumentation for computer vision, image understanding and optical computing
| AD-A198578 | N89-14723
**NEURONS**
Circuit behavior in the development of neuronal networks
| AD-A198040 | N89-14672
Information processing of complex sounds in the anteroventral cochlear nucleus
| AD-A198576 | N89-14673
**NEUROPHYSIOLOGY**
Functional significance and mechanisms of variability in baroreceptor reflex N89-14664
Circuit behavior in the development of neuronal networks
| AD-A198040 | N89-14672
Perceptual factors in workload: A neuromagnetic study
| AD-A198487 | N89-14681
**NEUTRON COUNTERS**
Predicted performance of a prototype solar neutron detector N89-15064
**NEUTRON SCATTERING**
Study of the localized vibrations of the hydrogen in solid solution Zr-O by inelastic neutron scattering
| DE88-702945 | N89-14866
**NEUTRON STARS**
Disk accretion onto weakly magnetized neutron stars
N89-15057
**NICKEL**
Low temperature heat capacities of several high strength materials
| AD-A198300 | N89-14299
**NICKEL ALLOYS**
Cyclic deformation, damage, and effects of environment in the Ni3Al ordered alloy at elevated temperatures
| AD-A198500 | N89-14300
**NIGHT**
Total ozone by lunar Dobson observation at Syowa, Antarctica N89-14504
**NIMBUS 7 SATELLITE**
Estimation of errors in the TOMS total ozone measurement during the Antarctica ozone campaign of August/September 1987 N89-14510
User's guide for the Nimbus 7 Scanning Multichannel Microwave Radiometer (SMMR) CELL-ALL tape
| NASA-RP-1210 | N89-14648
**NITRATES**
Filter measurements of chemical composition during the airborne Antarctic ozone experiment N89-14526
Antarctic polar stratospheric aerosols: The roles of nitrates, chlorides and sulfates N89-14527
**NITRIC ACID**
Persistence of Antarctic polar stratospheric clouds
N89-14521
Formation of polar stratospheric clouds simulated in a two dimensional model of the atmosphere N89-14529
Laboratory studies of HNO3/H2O mixtures at low temperatures N89-14533
Chemistry of chlorinated species in the Antarctic stratosphere N89-14598
**NITRIC OXIDE**
Correlation of N2O and ozone in the Southern Polar vortex during the airborne Antarctic ozone experiment
N89-14520
**NITRO COMPOUNDS**
Synthesis of new polynitropolyhedranes
| AD-A198320 | N89-14323
**NITROGEN**
Detection of ions by replacement-ion chromatography coupled to a microwave-induced nitrogen discharge at atmospheric pressure
| AD-A198800 | N89-14273
In-situ measurements of total reactive nitrogen, total water vapor, and aerosols in polar stratospheric clouds in the Antarctic stratosphere N89-14531
Modelling the Antarctic ozone hole N89-14605
**NITROGEN DIOXIDE**
Stratospheric column NO2 measurements from three Antarctic sites N89-14542
Ground-based measurements of O3, NO2, OClO, and BrO during the 1987 Antarctic ozone depletion event
N89-14543
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic
N89-14577
**NITROGEN IONS**
Implantation studies of hydrogen by field ion microscopy and spectroscopy
| DE88-016020 | N89-14293
**NITROGEN OXIDES**
Measurements of NO and total reactive odd-nitrogen, NOy, in the Antarctic stratosphere N89-14555
**NITROGEN POLYMERS**
Boron-nitride preceramic polymer studies
| AD-A197359 | N89-14309
Synthesis of new polynitropolyhedranes
| AD-A198320 | N89-14323
**NITROUS OXIDES**
Southern Hemispheric nitrous oxide measurements obtained during 1987 airborne Antarctic ozone experiment N89-14557
The effects of biomass burning on the concentration of trace gases in the atmosphere N89-14904
**NOISE INTENSITY**
Detailed design specification for a prototype Assessment System for Aircraft Noise (ASAN)
| AD-A197936 | N89-14818
**NOISE PREDICTION**
Users' manual for the Langley high speed propeller noise prediction program (DFP-ATP)
| NASA-CR-4208 | N89-14820
**NOISE PREDICTION (AIRCRAFT)**
Detailed design specification for a prototype Assessment System for Aircraft Noise (ASAN)
| AD-A197936 | N89-14818
**NOISE TOLERANCE**
Design of error control coding schemes for three problems of noisy information transmission, storage and processing
| B8811768 | N89-14371
**NOMOGRAPHS**
User's guide for executing OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms, version 4) with CBM-4 (Carbon-Bond Mechanism-4)
| PB88-221965 | N89-14609
**NONCONDENSABLE GASES**
Underexpanded noncondensing turbulent gas jets in liquids
| AD-A197939 | N89-14396
**NONDESTRUCTIVE TESTS**
Development of a contactless optoacoustic method for nondestructive testing. Part 2: Optical excitation of ultrasonic vibrations
| TPD-1987-0-2-PT-2 | N89-14454
The FIS electronics troubleshooting system
N89-14742
Reasoning about multiple faults N89-14743
Reconfigurable flight control: An opportunity for integrated diagnostics N89-14744
**NONLINEAR EQUATIONS**
Dynamic analysis of nonlinear rotor-housing systems
| NASA-CR-184611 | N89-14449
Finite-difference methods for solution of the many-dimensional nonlinear Schroedinger equation
| DE88-703772 | N89-14788
Numerical schemes in the stabilization method for nonlinear differential equations of second order
| DE88-703773 | N89-14789
**NONLINEAR SYSTEMS**
Design sensitivity analysis and optimization of nonlinear structures: A unified approach
| PB88-235171 | N89-14458
Finite element formulation for nonlinear viscoplastic material using a Q-model
| PB88-213764 | N89-14776
An asymptotic analysis of a class of nonlinear hyperbolic equations
| ETN-89-93352 | N89-14796
**NONLINEARITY**
Equivalent linearization for fatigue life estimates of a nonlinear structure N89-14919
The poststall nonlinear dynamics and control of an F-18: A preliminary investigation N89-14922
The influence of and the identification of nonlinearity in flexible structures N89-14932
Nonlinear magnetic reconnection N89-15052
**NONPARAMETRIC STATISTICS**
Nonparametric estimation of optimal performance criteria in quality engineering
| AD-A198315 | N89-14807
**NORMS**
On Hilbert-Schmidt norm convergence of Galerkin approximation for operator Riccati equations
| NASA-CR-181755 | N89-14798
**NORTHERN HEMISPHERE**
In situ observations of ClO in the wintertime Northern Hemisphere: ER-2 aircraft results from 21 N to 61 N latitude N89-14575
Comparison of the poleward transport of ozone in the Northern and Southern Hemispheres N89-14591
**NORWAY**
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
| AD-A198653 | N89-14484
Zone measurements during wintertime in the Arctic. Comparision with recent measurements at the same places are made. Here the 30 hPa Temperatures are shown
N89-14580
**NOZZLE FLOW**
Turbofan forced mixer lobe flow modeling. 1: Experimental and analytical assessment
| NASA-CR-4147-PT-1 | N89-14221
Turbofan forced mixer lobe flow modeling. 2: Three-dimensional inviscid mixer analysis (FLOMIX)
| NASA-CR-4147-PT-2 | N89-14222
**NUCLEAR FUELS**
The moon: An abundant source of clean and safe fusion fuel for the 21st century N89-14843
**NUCLEAR FUSION**
Starpower: The US and the international quest for fusion energy, contractor documents
| PB88-214663 | N89-14839
Lunar Helium-3 and Fusion Power
| NASA-CP-10018 | N89-14842
The moon: An abundant source of clean and safe fusion fuel for the 21st century N89-14843
Commercial objectives, technology transfer, and systems analysis for fusion power development
N89-14851
Low activation materials for fusion
| DE88-015561 | N89-14854
The physics of the high density Z-pinch
| DE88-016147 | N89-14855
Panel on high beta and/or high field tokamaks and stellarators
| DE88-017367 | N89-14859
**NUCLEAR MAGNETIC RESONANCE**
Condensation polymers with controlled structure
| AD-A198086 | N89-14321
Variable temperature solid state NMR of side-chain crystalline comb polymers
| AD-A198099 | N89-14322
Nuclear spin cooling using antiferromagnetic magnons
N89-14822
Methods of analysis of coupled spin-lattice relaxations and spin diffusion in heterogeneous organic solids with application to keratin N89-14823
**NUCLEAR PHYSICS**
The physics of the high density Z-pinch
| DE88-016147 | N89-14855
Technology and physics implications of oscillating-field current drive in reversed-field pinches
| DE89-000388 | N89-14861
**NUCLEAR POWER PLANTS**
Design of an obstacle avoidance system for AIMS
| DE88-016783 | N89-14446
**NUCLEAR POWER REACTORS**
Commercial objectives, technology transfer, and systems analysis for fusion power development
N89-14851
**NUCLEAR RADIATION**
The future of intelligent spectrometers in metal speciation by atomic emission spectrometry
| AD-A198592 | N89-14287

**NUCLEAR REACTORS**
Nuclear reactor power as applied to a space-based radar mission
| NASA-TM-101200 | N89-14831
**NUCLEAR RESEARCH**
Strategy for D/He-3 fusion development N89-14846
**NUCLEAR SPIN**
Nuclear spin cooling using antiferromagnetic magnons N89-14822
**NUCLEATION**
Particle formation and interaction N89-15001
Nucleation and particle coagulation experiments in microgravity N89-15030
Experimental correlation of melt structures, nucleation rates, and thermal histories of silicate melts N89-15044
**NUMERICAL ANALYSIS**
Numerical analysis of flow through oscillating cascade sections
| NASA-TM-101417 | N89-14220
A numerical simulation of the full two-dimensional electrothermal de-icer pad
| NASA-CR-4194 | N89-14235
Numerical methods to solve the problem of scattering from electrically large bodies
| AD-A198098 | N89-14359
Electromagnetic penetration through finite-length narrow slots in planar conducting screens
| DE88-016046 | N89-14370
A numerical simulation of the flow field and heat transfer in a rectangular passage with a turbulence promoter
| AD-A198579 | N89-14400
Dynamics of structures: Solution techniques
| DE88-017022 | N89-14461
Research conducted at the Institute for Computer Applications in Science and Engineering in applied mathematics, numerical analysis and computer science
| NASA-CR-181757 | N89-14694
Research instrumentation for computer vision, image understanding and optical computing
| AD-A198578 | N89-14723
Numerical simulation of injection molding: Non-isothermal non-Newtonian flow of polymers in complex geometries
| ETN-89-93348 | N89-14727
Summaries of the FY88 applied mathematical sciences research program
| DE89-000242 | N89-14784
Numerical optimization
| AD-A198586 | N89-14793
Semiclassical corrections for inelastic atom-surface scattering from classical trajectories
| AD-A198636 | N89-14827
**NUMERICAL WEATHER FORECASTING**
Semi-prognostic tests of cumulus parameterization schemes in the middle latitudes
| PB88-236013 | N89-14639
Numerical atmospheric models
| KNMI-TR-107 | N89-14649
**NUTRITION**
Space shuttle food system summary, 1981-1986
| NASA-TM-100469 | N89-14693


## O


**OBJECT PROGRAMS**
Object-oriented systems: An annotated bibliography
| NASA-CR-184551 | N89-14991
**OBSERVATION**
Photochemical modeling of the Antarctic stratosphere: Observational constraints from the airborne Antarctic ozone experiment and implications for ozone behavior N89-14569
In situ observations of ClO in the wintertime Northern Hemisphere: ER-2 aircraft results from 21 N to 61 N latitude N89-14575
**OBSERVATORIES**
The Baksan Neutrino Observatory Soviet-American Gallium Solar Neutrino Experiment
| DE89-000375 | N89-15061
**OBSTACLE AVOIDANCE**
Design of an obstacle avoidance system for AIMS
| DE88-016783 | N89-14446
**OCCULTATION**
Persistence of Antarctic polar stratospheric clouds N89-14521
**OCEAN BOTTOM**
Heat flow and magnetization in the oceanic lithosphere
| NASA-CR-183346 | N89-14653
Qualitative aspects of seismograph/ocean bottom interaction
| AD-A198652 | N89-14656
**OCEAN CURRENTS**
The role of horizontal processes in upper-ocean prediction: A forecast simulation in the Sea of Japan
| AD-A198827 | N89-14654
**OCEAN MODELS**
The role of horizontal processes in upper-ocean prediction: A forecast simulation in the Sea of Japan
| AD-A198827 | N89-14654
**OCEAN SURFACE**
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
| AD-A198653 | N89-14484
Summary of along-track data from the earth radiation budget satellite for several representative ocean regions
| NASA-RP-1206 | N89-14634
Energy dissipation of monochromatic sea waves in the turbulent boundary layer
| KNMI-TR-104 | N89-14657
**OCEANOGRAPHY**
The role of horizontal processes in upper-ocean prediction: A forecast simulation in the Sea of Japan
| AD-A198827 | N89-14654
**OCEANS**
Chemical variability in ocean frontal areas
| AD-A198418 | N89-14655
**OCTANES**
The surface enhanced raman scattering of the protonated forms of DABCO at a silver electrode
| AD-A197930 | N89-14278
**OILS**
An investigation into fluid film lubrication in dynamically loaded bearings N89-14442
**ONBOARD EQUIPMENT**
A flight expert system (FLES) for on-board fault monitoring and diagnosis N89-14753
On-board expert diagnostics for an avionics subsystem N89-14758
Avionics fault tree analysis and artificial intelligence for future aircraft maintenance N89-14760
**OPEN CIRCUIT VOLTAGE**
A national intercomparison of hydrophone calibration methods
| NPL-AC-116 | N89-14819
**OPERATING SYSTEMS (COMPUTERS)**
A performance evaluation of the IBM 370/XT personal computer
| NASA-CR-184542 | N89-14982
IBM PC/IX operating system evaluation plan
| NASA-CR-184546 | N89-14986
NASA PC software evaluation project
| NASA-CR-184550 | N89-14990
**OPERATIONS RESEARCH**
Network management of highly adaptive communication networks
| AD-A198429 | N89-14362
**OPERATORS (MATHEMATICS)**
Semigroups of operators, approximation and saturation in Banach spaces
| ETN-89-93353 | N89-14813
**OPTICAL COMMUNICATION**
Detector evaluation for optical signals
| AD-A198133 | N89-14836
**OPTICAL DATA PROCESSING**
Possible measurement errors in calibrated AVHRR (Advanced Very High Resolution Radiometer) data
| AD-A198342 | N89-14414
Research instrumentation for computer vision, image understanding and optical computing
| AD-A198578 | N89-14723
Integrated acoustooptic device modules for optical information processing
| AD-A198061 | N89-14835
**OPTICAL FIBERS**
Consideration of ionizing radiation shielding for optical fibers
| PB88-237029 | N89-14817
Radiation-induced transient absorption in single mode optical fibers
| DE89-000392 | N89-14832
Multi-object astronomical spectroscopy with optical fibres N89-15048
**OPTICAL MEMORY (DATA STORAGE)**
CD-ROM (Compact Disc Read Only Memory) library of the future
| AD-A197943 | N89-14702
**OPTICAL PROPERTIES**
Rheological and rheo-optical studies with nematogenic solutions of a rodlike polymer: A review of data on poly(phenylene benzobisthiazole)
| AD-A197994 | N89-14318
Optical and infrared properties of the marine atmosphere, phase 1
| FEL-1987-76 | N89-14630
Determination of optical properties by inversion of multiple scattering data: Experimental program
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Semiconducting transition metal silicides: New materials for optoelectronics on silicon
| AD-A198139 | N89-14881
**OPTICAL PUMPING**
Subpicosecond, high-brightness excimer laser systems
| DE88-016239 | N89-14430
**OPTICAL RADAR**
Large-scale variations in ozone and polar stratospheric clouds measured with airborne lidar during formation of the 1987 ozone hole over Antarctica N89-14525
**OPTICAL WAVEGUIDES**
Mechanisms of radiation damage generated by ionizing radiation in optical waveguides
| AD-A198030 | N89-14834
**OPTIMIZATION**
Heat exchanger optimization N89-14391
System for the optimum design of structures
| ETN-89-93599 | N89-14451
Design sensitivity analysis and optimization of nonlinear structures: A unified approach
| PB88-235171 | N89-14458
Synthesis of graphical displays for tabular data
| AD-A198979 | N89-14707
Hg,CdTe material optimization for carrier lifetime maximization
| AD-A198101 | N89-14880
Optimization of slender wings for center-of-pressure shift due to change in Mach number N89-14897
**ORBIT TRANSFER VEHICLES**
Aeroassisted orbital transfer vehicle control technology
| NASA-CR-179424 | N89-14250
Orbit transfer rocket engine technology program: Oxygen materials compatibility testing
| NASA-CR-182195 | N89-14256
**ORBITAL ASSEMBLY**
Design of an obstacle avoidance system for AIMS
| DE88-016783 | N89-14446
End-effector - joint conjugates for robotic assembly of large truss structures in space: A second generation N89-14898
**ORBITAL MECHANICS**
Simulation and analysis of a Geopotential Research Mission N89-14478
**ORBITAL POSITION ESTIMATION**
Geolocation via satellite: A methodology and error analysis
| AD-A197955 | N89-14253
**ORDNANCE**
Expert Missile Maintenance Aid (EMMA): An application of artificial intelligence technology to the munition maintenance domain N89-14748
**ORGANIC COMPOUNDS**
A solar photochemical process for destroying organics in water
| DE89-000503 | N89-14277
The synthesis and structure of polyphosphazenes
| AD-A198519 | N89-14329
**ORGANIC MATERIALS**
A synthetic route to organic aerogels: Mechanism, structure, and properties
| DE88-017112 | N89-14317
**ORGANIC SEMICONDUCTORS**
The synthesis and structure of polyphosphazenes
| AD-A198519 | N89-14329
**ORGANOMETALLIC POLYMERS**
The synthesis and structure of polyphosphazenes
| AD-A198519 | N89-14329
**ORTHOSTATIC TOLERANCE**
Influence of high temperature on total gas metabolism of animals with limitation of motor activity N89-14661
**OSCILLATIONS**
On exceedance point processes for stationary sequences under mild oscillation restrictions
| AD-A198314 | N89-14806
Technology and physics implications of oscillating-field current drive in reversed-field pinches
| DE89-000388 | N89-14861
**OSCILLATOR STRENGTHS**
Stellar masses and laboratory astrophysics N89-15056
**OSCILLATORS**
Investigation of RF excited CW CO2 waveguide lasers local oscillator - RF excitation
| NASA-CR-183344 | N89-14427
High-power microwave source development at Los Alamos
| DE89-000327 | N89-14830
**OSTEOPOROSIS**
Effects of calcitonin and retabolil on rat femur in hypokinesia N89-14659

**OXIDATION**
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
| NASA-TM-100459-VOL-1 | N89-14331
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
| NASA-TM-100459-VOL-2 | N89-14332
Thermal analysis system (DSC, TGA, TMA) for oxidation and phase transformation studies of alloys with mestable phase
| AD-A198420 | N89-14415
The effects of atomic oxygen on polymeric materials N89-14921
Pretreatment of CO oxidation catalysts N89-14930
**OXIDATION RESISTANCE**
Oxidation behavior of FeAl + Hf,Zr,B
| NASA-TM-101402 | N89-14297
**OXIDATION-REDUCTION REACTIONS**
A spectroscopic characterization of the structure of supported metal catalysts
| B8811777 | N89-14889
A system for conducting igneous petrology experiments under controlled redox conditions in reduced gravity N89-15040
**OXIDES**
In situ observations of ClO in the wintertime Northern Hemisphere: ER-2 aircraft results from 21 N to 61 N latitude N89-14575
In situ observations of BrO over Antarctica: ER-2 aircraft results from 54 S to 72 S latitude N89-14583
**OXYGEN**
Orbit transfer rocket engine technology program: Oxygen materials compatibility testing
| NASA-CR-182195 | N89-14256
Adsorption of chlorine on clean and on oxygen pre-exposed Al(3)
| AD-A198005 | N89-14280
The effects of atomic oxygen on polymeric materials N89-14921
**OXYGEN CONSUMPTION**
Systemic hemodynamic shifts in hypoxia N89-14665
**OXYGEN TENSION**
Effects of low and high oxygen tensions and related respiratory conditions on visual performance: A literature review
| AD-A198688 | N89-14669
**OZONE**
Polar Ozone Workshop. Abstracts
| NASA-CP-10014 | N89-14503
Total ozone by lunar Dobson observation at Syowa, Antarctica N89-14504
Total ozone changes in the 1987 Antarctic ozone hole N89-14505
The breakup of the Southern Hemisphere spring polar ozone and temperature minimums from 1979 to 1987 N89-14506
Observations of stratospheric temperature changes coincident with the recent Antarctic ozone depletions N89-14507
Antarctic measurements of ozone, water vapor, and aerosol extinction by Sage 2 in the spring of 1987 N89-14508
The threee-dimensional morphology of the Antarctic ozone hole N89-14509
Estimation of errors in the TOMS total ozone measurement during the Antarctica ozone campaign of August/September 1987 N89-14510
NMC stratospheric analyses during the 1987 Antarctic expedition N89-14511
The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
Seasonal and temporal changes in the vertical profiles of polar stratospheric ozone: 1978-1986 N89-14513
Ozone profile measurements at McMurdo Station Antarctica during the spring of 1987 N89-14514
Dynamics Explorer 1 SOI images of the Antarctic ozone hole N89-14515
The morphology and meteorology of Southern Hemisphere spring total ozone mini-holes N89-14516
GHOST balloons around Antarctica N89-14517
Ozone profiles above Palmer Station, Antarctica N89-14518
Total ozone, ozone vertical distributions, and stratospheric temperatures at South Pole, Antarctica, in 1986 and 1987 N89-14519
Correlation of N2O and ozone in the Southern Polar vortex during the airborne Antarctic ozone experiment N89-14520
Persistence of Antarctic polar stratospheric clouds N89-14521
Comparison of in situ aerosol measurements with SAGE 2 and SAM 2 aerosol measurements during the airborne Antarctic ozone experiment N89-14522
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
Large-scale variations in ozone and polar stratospheric clouds measured with airborne lidar during formation of the 1987 ozone hole over Antarctica N89-14525
Photochemical modeling of the Antarctic stratosphere: Observational constraints from the airborne Antarctic ozone experiment and implications for ozone behavior N89-14569
Variations of total ozone in the north polar region as seen by TOMS N89-14571
Visible and near-ultraviolet spectroscopy at Thule AFB (76.5 N) from January 28 - February 15, 1988 N89-14576
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic N89-14577
Springtime surface ozone fluctuations at high Arctic latitudes and their possible relationship to atmospheric bromine N89-14581
Airborne measurements of tropospheric ozone destruction and particulate bromide formation in the Arctic N89-14582
The QBO and interannual variation in total ozone N89-14584
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585
Global impact of the Antarctic ozone hole: Simulations with a 3-D chemical transport model N89-14586
Polar vortex dynamics N89-14588
Evolution of the Antarctic polar vortex in spring: Response of a GCM to a prescribed Antarctic ozone hole N89-14589
Theoretical study of polar and global ozone changes using a coupled radiative-dynamical 2-D model N89-14590
Comparison of the poleward transport of ozone in the Northern and Southern Hemispheres N89-14591
Radiative aspects of Antarctic ozone hole in 1985 N89-14592
A two-dimensional model of the quasi biennial oscillation of ozone N89-14596
Chemistry of chlorinated species in the Antarctic stratosphere N89-14598
Stability and photochemistry of ClO dimers formed at low temperature in the gas phase N89-14600
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product N89-14601
Chemistry of the CO dimer at low temperatures N89-14602
Modelling the Antarctic lower stratosphere N89-14603
The chemistry of Antarctic ozone 1960-1987 N89-14604
Modelling the Antarctic ozone hole N89-14605
High resolution FTIR spectroscopy of the ClO radical N89-14607
Analysis of crop loss for alternative ozone exposure indices
| PB88-214788 | N89-14608
**OZONE DEPLETION**
Polar Ozone Workshop. Abstracts
| NASA-CP-10014 | N89-14503
Total ozone changes in the 1987 Antarctic ozone hole N89-14505
The breakup of the Southern Hemisphere spring polar ozone and temperature minimums from 1979 to 1987 N89-14506
Observations of stratospheric temperature changes coincident with the recent Antarctic ozone depletions N89-14507
Antarctic measurements of ozone, water vapor, and aerosol extinction by Sage 2 in the spring of 1987 N89-14508
The threee-dimensional morphology of the Antarctic ozone hole N89-14509
Estimation of errors in the TOMS total ozone measurement during the Antarctica ozone campaign of August/September 1987 N89-14510
The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
Seasonal and temporal changes in the vertical profiles of polar stratospheric ozone: 1978-1986 N89-14513
Ozone profile measurements at McMurdo Station Antarctica during the spring of 1987 N89-14514
Dynamics Explorer 1 SOI images of the Antarctic ozone hole N89-14515
The morphology and meteorology of Southern Hemisphere spring total ozone mini-holes N89-14516
GHOST balloons around Antarctica N89-14517
Ozone profiles above Palmer Station, Antarctica N89-14518
Total ozone, ozone vertical distributions, and stratospheric temperatures at South Pole, Antarctica, in 1986 and 1987 N89-14519
Correlation of N2O and ozone in the Southern Polar vortex during the airborne Antarctic ozone experiment N89-14520
Comparison of in situ aerosol measurements with SAGE 2 and SAM 2 aerosol measurements during the airborne Antarctic ozone experiment N89-14522
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
Large-scale variations in ozone and polar stratospheric clouds measured with airborne lidar during formation of the 1987 ozone hole over Antarctica N89-14525
Laboratory studies of HNO3/H2O mixtures at low temperatures N89-14533
Evolution of polar stratospheric clouds during the Antarctic winter N89-14534
Heterogeneous physicochemistry of the winter polar stratosphere N89-14535
Heterogeneous chemistry related to Antarctic ozone depletion: Reaction of ClONO2 and N2O5 on ice surfaces N89-14537
Mass accommodation coefficient measurements for HNO3, HCl and N2O5 on water, ice and aqueous sulfuric acid droplet surfaces N89-14538
Laboratory studies of sticking coefficients and heterogeneous reactions important in the stratosphere N89-14539
Lidar observations of polar stratospheric clouds at McMurdo, Antarctica, during NOZE-2 N89-14540
Observations of condensation nuclei in the 1987 airborne Antarctic ozone experiment N89-14541
Stratospheric column NO2 measurements from three Antarctic sites N89-14542
Ground-based measurements of O3, NO2, OClO, and BrO during the 1987 Antarctic ozone depletion event N89-14543
Near UV atmospheric absorption measurements from the DC-8 aircraft during the 1987 airborne Antarctic ozone experiment N89-14544
Infrared measurements of column amounts of stratospheric constituents in the Antarctic winter, 1987 N89-14545
Infrared measurements in the spring 1987 ozone hole N89-14547
Quantitative observations of the behavior of anomalous low altitude ClO in the Antarctic spring Stratosphere, 1987 N89-14548
Daytime ClO over McMurdo in September 1987: Altitude profile retrieval accuracy N89-14549
Temporal and spatial distribution of stratospheric trace gases over Antarctica in August and September, 1987 N89-14551
Measurements of ozone in the Antarctic region during August and September of 1987 N89-14552
In situ observations of ClO in the Antarctic: Evidence for chlorine catalyzed destruction of ozone N89-14554
Measurements of NO and total reactive odd-nitrogen, NOy, in the Antarctic stratosphere N89-14555
Southern Hemispheric nitrous oxide measurements obtained during 1987 airborne Antarctic ozone experiment N89-14557
Observational results of microwave temperature profile measurements from the airborne Antarctic ozone experiment N89-14558
Temporal trends and transport within and around the Antarctic polar vortex during the formation of the 1987 Antarctic ozone hole N89-14565
Decending motion of particle and its effect on ozone hole chemistry N89-14570
Wintertime losses of ozone in high northern latitudes N89-14572
CANOZE measurements of the Arctic ozone hole N89-14578
Brewer spectrophotometer measurements in the Canadian Arctic N89-14579
Airborne measurements of tropospheric ozone destruction and particulate bromide formation in the Arctic N89-14582
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585
Global impact of the Antarctic ozone hole: Simulations with a 3-D chemical transport model N89-14586
Polar vortex dynamics N89-14588
Evolution of the Antarctic polar vortex in spring: Response of a GCM to a prescribed Antarctic ozone hole N89-14589
Comparison of the poleward transport of ozone in the Northern and Southern Hemispheres N89-14591
Radiative aspects of Antarctic ozone hole in 1985 N89-14592
Simulation of the transport of halogen species from the equatorial and mid-latitude stratosphere to the polar stratosphere in a two-dimensional model N89-14595
A two-dimensional model of the quasi biennial oscillation of ozone N89-14596

Chemistry of chlorinated species in the Antarctic stratosphere N89-14598
Studies of ClO and BrO reactions important in the polar stratosphere: Kinetics and mechanism of the ClO + BrO and ClO + ClO reactions N89-14599
Stability and photochemistry of ClO dimers formed at low temperature in the gas phase N89-14600
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product N89-14601
Chemistry of the CO dimer at low temperatures N89-14602
Modelling the Antarctic lower stratosphere N89-14603
The chemistry of Antarctic ozone 1960-1987 N89-14604
Modelling the Antarctic ozone hole N89-14605
High resolution FTIR spectroscopy of the ClO radical N89-14607
Assessing the risks of trace gases that can modify the stratosphere. Volume 1: Executive summary
|PB88-231055| N89-14610
Assessing the risks of trace gases that can modify the stratosphere. Volume 6: Technical support documentation production projections
|PB88-231071| N89-14611
Assessing the risks of trace gases that can modify the stratosphere. Volume 7: Technical support documentation atmospheric science papers
|PB88-231089| N89-14612
Assessing the risks of trace gases that can modify the stratosphere. Volume 8: Technical support documentation ozone depletion and plants
|PB88-231097| N89-14613

**OZONOMETRY**
Polar Ozone Workshop. Abstracts
|NASA-CP-10014| N89-14503
Total ozone by lunar Dobson observation at Syowa, Antarctica N89-14504
Total ozone changes in the 1987 Antarctic ozone hole N89-14505
The breakup of the Southern Hemisphere spring polar ozone and temperature minimums from 1979 to 1987 N89-14506
Antarctic measurements of ozone, water vapor, and aerosol extinction by Sage 2 in the spring of 1987 N89-14508
Estimation of errors in the TOMS total ozone measurement during the Antarctica ozone campaign of August/September 1987 N89-14510
The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
Dynamics Explorer 1 SOI images of the Antarctic ozone hole N89-14515
The morphology and meteorology of Southern Hemisphere spring total ozone mini-holes N89-14516
Ozone profiles above Palmer Station, Antarctica N89-14518
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
Temperature and horizontal wind measurements on the ER-2 aircraft during the 1987 airborne Antarctic ozone experiment N89-14560
Wintertime losses of ozone in high northern latitudes N89-14572
CANOZE measurements of the Arctic ozone hole N89-14578
Zone measurements during wintertime in the Arctic. Comparision with recent measurements at the same places are made. Here the 30 hPa Temperatures are shown N89-14580
User's guide for executing OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms, version 4) with CBM-4 (Carbon-Bond Mechanism-4)
|PB88-221965| N89-14609

## P

**PAIR PRODUCTION**
Pair production and annihilation in gamma-ray bursts N89-15065

**PANIC**
An inquiry into panic and its differentiation from other types of anxiety N89-14679

**PARABOLIC DIFFERENTIAL EQUATIONS**
Numerical grid generation and potential airfoil analysis and design
|AD-A197972| N89-14219

**PARALLEL COMPUTERS**
High performance parallel computers for science: New developments at the Fermilab Advanced Computer Program
|DE88-016465| N89-14733

**PARALLEL PROCESSING (COMPUTERS)**
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
|AD-A198656| N89-14367
High performance parallel computers for science: New developments at the Fermilab Advanced Computer Program
|DE88-016465| N89-14733
Parallel processing techniques for the simulation of MOS VLSI circuits using waveform relaxation
|AD-A197879| N89-14734
Parallel heterogeneous mesh refinement for advective-diffusive equations
|DE88-017026| N89-14786

**PARAMETER IDENTIFICATION**
Computation of algebraic polynomial parametric surface intersections
|PB88-208277| N89-14778
Estimation of parameters and the goodness-of-fit test for multivariate distributions for data presented as one-dimensional histograms
|DE88-703697| N89-14803

**PARAMETERIZATION**
Identification of dynamic parameters of a squeeze-film bearing N89-14443
Semi-prognostic tests of cumulus parameterization schemes in the middle latitudes
|PB88-236013| N89-14639
A note on second order effects in a semiparametric context
|AD-A198018| N89-14804

**PARASITES**
The effect of parasitic absorption losses on light trapping in thin silicon solar cells
|DE89-000457| N89-14501

**PARTIAL DIFFERENTIAL EQUATIONS**
Dynamics of structures: Fundamentals
|DE88-017027| N89-14462

**PARTICLE ACCELERATION**
Progress toward inertial fusion with light ion beams at Sandia National Laboratories
|DE88-016693| N89-14862

**PARTICLE ACCELERATORS**
Electromagnetic time-domain calculations in two and three dimensions
|DE89-000311| N89-14355

**PARTICLE COLLISIONS**
Constitutive relations for rapidly sheared granular flows: A Monte Carlo form based on the kinetic theory of dense gases N89-14387
Particle formation and interaction N89-15001
The orbit properties of colliding co-orbiting bodies N89-15013
Debris-cloud collisions: Accretion studies in the Space Station N89-15033
Impacts of free-floating objects: Unique Space Station experiments N89-15034
How to make a comet N89-15035

**PARTICLE DIFFUSION**
Daylight and twilight sky radiance and terrestrial irradiance
|AD-A198550| N89-14628

**PARTICLE INTERACTIONS**
Green's function Monte Carlo calculations of 4He
|DE89-000379| N89-14802
Research Program in Elementary Particle Theory
|DE88-017241| N89-14891
Experiments in Planetary and Related Sciences and the Space Station
|NASA-CP-2494| N89-14998
Predicted performance of a prototype solar neutron detector N89-15064

**PARTICLE MOTION**
Decending motion of particle and its effect on ozone hole chemistry N89-14570

**PARTICLE SIZE DISTRIBUTION**
Comparison of in situ aerosol measurements with SAGE 2 and SAM 2 aerosol measurements during the airborne Antarctic ozone experiment N89-14522
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
On the size and composition of particles in polar stratospheric clouds N89-14528

**PARTICLE THEORY**
Research Program in Elementary Particle Theory
|DE88-017241| N89-14891

**PARTICLE TRACKS**
Predicted performance of a prototype solar neutron detector N89-15064

**PARTICLE TRAJECTORIES**
Investigation of the enhanced spatial density of submicron lunar ejecta between L values 1.2 and 3.0 in the earth's magnetosphere: Theory N89-15007
The orbit properties of colliding co-orbiting bodies N89-15013

**PARTICLES**
Constitutive relations for rapidly sheared granular flows: A Monte Carlo form based on the kinetic theory of dense gases N89-14387
Physics of windblown particles N89-15000
Development and testing of a unique carousel wind tunnel to experimentally determine the effect of gravity and the interparticle force on the physics of wind-blown particles
|WHITE, BRUCE R.| N89-15022
Electrostatic aggregation of finely-comminuted geological materials N89-15027
Aeolian processes aboard a Space Station: Saltation and particle trajectory analysis N89-15039

**PARTICULATE SAMPLING**
Aircraft emissions characterization
|AD-A197864| N89-14617

**PARTICULATES**
Airborne measurements of tropospheric ozone destruction and particulate bromide formation in the Arctic N89-14582

**PASSIVITY**
The development of iron-aluminium based alloys for aqueous corrosion resistance N89-14291

**PATENTS**
US photovoltaic patents, 1951--1987
|DE88-001178| N89-14497

**PATTERN RECOGNITION**
Precision of line following in digital images
|B8821610| N89-14486
Pattern-directed invocation with changing equalities
|AD-A198146| N89-14715
A 3-D object recognition system using aspect graphs
|AD-A198472| N89-14720

**PENETRANTS**
Durability of adhesive joints: An engineering study
|PB88-233473| N89-14307

**PENETRATION**
Electromagnetic penetration through finite-length narrow slots in planar conducting screens
|DE88-016046| N89-14370
Magnetic field penetration into the high temperature superconductor YBa2Cu3O(sub 7-x)
|DE89-000547| N89-14873

**PERFORMANCE PREDICTION**
Dynamic analysis of nonlinear rotor-housing systems
|NASA-CR-184611| N89-14449
Nonparametric estimation of optimal performance criteria in quality engineering
|AD-A198315| N89-14807
Predicted performance of a prototype solar neutron detector N89-15064

**PERFORMANCE TESTS**
Fabrication and testing of lightweight hydraulic system simulator hardware. Phase 2: Addendum
|AD-A198524| N89-14243
Ceramics: Materials for severe environments
|PB88-240049| N89-14308
ETX-I: First-generation single-shaft electric propulsion system program. Volume 2: Battery
|DE89-000079| N89-14378
New absolute gravity instruments for physics and geophysics N89-14404
Qualitative aspects of seismograph/ocean bottom interaction
|AD-A198652| N89-14656
The birth of the second generation: The Hitachi S-820/80
|DE88-014439| N89-14697
ELEFUNT test results under FORTRAN-PLUS on the active memory technology DAP 510-8
|DE88-017264| N89-14700
Incorporating design for test into an IC design expert system N89-14746
Artificial intelligence in test program development N89-14769
Use of laser diodes for analog fiber optic diagnostics systems
|DE88-017012| N89-14833
USL/DBMS NASA/PC R and D project system testing standards
|NASA-CR-184545| N89-14985
Development and testing of a unique carousel wind tunnel to experimentally determine the effect of gravity and the interparticle force on the physics of wind-blown particles
|WHITE, BRUCE R.| N89-15022

**PERIODICALS**
Object-oriented systems: An annotated bibliography
|NASA-CR-184551| N89-14991

**PERSONAL COMPUTERS**
Transportable educational programs for scientific and technical professionals: More effective utilization of automated scientific and technical data base systems
[NASA-CR-184507] N89-14947
Transportable, university-level educational programs in interactive information storage and retrieval systems
[NASA-CR-184511] N89-14951
A report on the USL NASA/RECON project. Part 2: PC-based R and D in support of IS and R applications
[NASA-CR-184516] N89-14956
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems
[NASA-CR-184523] N89-14963
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems. Presentation visuals
[NASA-CR-184524] N89-14964
An overview of the USL/DBMS NASA/PC R and D project working paper series
[NASA-CR-184533] N89-14973
The USL NASA PC R and D project: General specifications of objectives
[NASA-CR-184534] N89-14974
The USL NASA PC R and D development environment standards
[NASA-CR-184535] N89-14975
General specifications for the development of a PC-based simulator of the NASA RECON system
[NASA-CR-184536] N89-14976
General specifications for the development of a USL/DBMS NASA/PC R and D distributed workstation
[NASA-CR-184538] N89-14978
The USL NASA PC R and D interactive presentation development system
[NASA-CR-184539] N89-14979
The USL NASA PC R and D project: Detailed specifications of objects
[NASA-CR-184540] N89-14980
A performance evaluation of the IBM 370/XT personal computer
[NASA-CR-184542] N89-14982
USL/DBMS NASA/PC R and D project C programming standards
[NASA-CR-184543] N89-14983
USL/DBMS NASA/PC R and D project system design standards
[NASA-CR-184544] N89-14984
USL/DBMS NASA/PC R and D project system testing standards
[NASA-CR-184545] N89-14985
IBM PC/IX operating system evaluation plan
[NASA-CR-184546] N89-14986
PC-based Multiple Information System Interface (PC/MISI) design plan
[NASA-CR-184547] N89-14987
PC-based Multiple Information System Interface (PC/MISI) detailed design and implementation plan
[NASA-CR-184548] N89-14988
An overview of the evaluation plan for PC/MISI: PC-based Multiple Information System Interface
[NASA-CR-184549] N89-14989
NASA PC software evaluation project
[NASA-CR-184550] N89-14990
A programming environment evaluation methodology for object-oriented systems
[NASA-CR-184552] N89-14992
**PERSONNEL**
Human factors in the Naval Air Systems Command: Computer based training
[DE88-015301] N89-14686
Artificial intelligence technology for the maintainer's associate N89-14752
**PERSONNEL DEVELOPMENT**
Comparative study of career development and training programs N89-14927
**PETROLOGY**
A system for conducting igneous petrology experiments under controlled redox conditions in reduced gravity N89-15040
Containerless high-pressure petrology experiments in the microgravity environment of the Space Station N89-15045
**PH**
Determination of pH by flow injection analysis and by fiber optrode analysis
[PB88-235502] N89-14270
**PHASE COHERENCE**
Josephson junction arrays with positional disorder: Experiments and simulations N89-14867
**PHASE DIAGRAMS**
Grain boundary phase equilibria in metallic systems
[DE89-000026] N89-14294
Ternary solid phase equilibria in the systems (Ag,In,Au)-(Cd,He)-Te
[AD-A198679] N89-14302
**PHASE SHIFT KEYING**
A concatenated coded modulation scheme for error control (addition 2)
[NASA-CR-183260] N89-14706
**PHASE TRANSFORMATIONS**
Grain boundary phase equilibria in metallic systems
[DE89-000026] N89-14294
Thermal analysis system (DSC, TGA, TMA) for oxidation and phase transformation studies of alloys with mestable phase
[AD-A198420] N89-14415
Phase transformation and enhanced nuclear resonance in acoustics N89-14816
**PHENOLIC RESINS**
The effect of high heating rate on the pyrolysis of polymeric and composite materials
[AD-A198052] N89-14319
**PHENOLS**
Statistical characterization of carbon phenolic prepreg materials, volume 1
[NASA-CR-179416] N89-14306
**PHONONS**
Molecular beam studies of surface phonons and gas surface interactions
[AD-A198435] N89-14826
Acoustic phonon scattering in modulation doped Aluminum (subx) Gallium (sub 1x) Arsenide/Gallium arsenide heterojunctions
[AD-A198512] N89-14885
**PHOSPHAZENE**
The synthesis and structure of polyphosphazenes
[AD-A198519] N89-14329
**PHOTOABSORPTION**
HANEX simulations of laser-target interactions: 1. Radiation processes
[AD-A197965] N89-14438
**PHOTOCATHODES**
Detector evaluation for optical signals
[AD-A198133] N89-14836
**PHOTOCHEMICAL REACTIONS**
A solar photochemical process for destroying organics in water
[DE89-000503] N89-14277
Ionization rates relevant to laser cooling of hydrogen
[AD-A198481] N89-14440
Photochemical trajectory modelling studies of the 1987 Antarctic spring vortex N89-14559
Photochemical modeling of the Antarctic stratosphere: Observational constraints from the airborne Antarctic ozone experiment and implications for ozone behavior N89-14569
Global impact of the Antarctic ozone hole: Simulations with a 3-D chemical transport model N89-14586
Stability and photochemistry of ClO dimers formed at low temperature in the gas phase N89-14600
Modelling the Antarctic lower stratosphere N89-14603
**PHOTOCONDUCTIVITY**
Surface flashover threshold and switched fields of photoconductive semiconductor switches
[DE88-011618] N89-14876
**PHOTOCONDUCTORS**
Surface flashover threshold and switched fields of photoconductive semiconductor switches
[DE88-011618] N89-14876
**PHOTODECOMPOSITION**
Chemistry of the CO dimer at low temperatures N89-14602
**PHOTOGRAMMETRY**
The use of short range stereophotogrammetry for facial asymmetry and growth studies; analysis and model
[B8821611] N89-14491
**PHOTOLITHOGRAPHY**
Radiation sensitivity of soluble polysilane derivatives: Science and applications
[AD-A198805] N89-14313
**PHOTOLYSIS**
Transient behaviors in chemical reactions: Nanosecond infrared spectroscopy, chemically pumped visible and near-IR lasers
[AD-A198484] N89-14286
Studies of ClO and BrO reactions important in the polar stratosphere: Kinetics and mechanism of the ClO + BrO and ClO + ClO reactions N89-14599
**PHOTOMAPPING**
FRANK: Some aspects of the processing of observations using the interpretation instrument; measuring methods, instrumental errors and preprocessing of the observations — FRANK; a system for photographic registration of topography for analog image presentation and map manufacturing
[ETN-89-93338] N89-14494
**PHOTOMASKS**
A fast ion beam pattern generator
[ETN-89-93354] N89-14350
**PHOTOMETERS**
Comparison of in situ aerosol measurements with SAGE 2 and SAM 2 aerosol measurements during the airborne Antarctic ozone experiment N89-14522
**PHOTOMICROGRAPHY**
High-Speed Microphotographic Laboratory
[DE88-017009] N89-14411
**PHOTOMULTIPLIER TUBES**
Molecular spectroscopy using charge transfer device detectors
[AD-A198593] N89-14288
Comparison of charge transfer device and photomultiplier tube performance for extremely low photon fluxes
[AD-A198594] N89-14382
**PHOTONS**
Comparison of charge transfer device and photomultiplier tube performance for extremely low photon fluxes
[AD-A198594] N89-14382
**PHOTOSPHERE**
Magnetic properties of C 4 Doppler shift patterns
[AD-A198602] N89-15062
**PHOTOSYNTHESIS**
Powerful photogenerated reducing agents
[AD-A197949] N89-14279
**PHOTOVOLTAIC CELLS**
Design of fault-tolerant circuits for photovoltaic concentrators
[DE89-001062] N89-14379
US photovoltaic patents, 1951--1987
[DE88-001178] N89-14497
Crystalline silicon photovoltaic cell technology: Meeting the challenge for utility power
[DE89-000439] N89-14500
**PHOTOVOLTAIC CONVERSION**
Photovoltaics as an operating energy system
[DE88-017167] N89-14498
**PHYSICAL EXERCISE**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
[AD-A197472] N89-14668
**PHYSICAL WORK**
Working in impermeable clothing: Criteria for maximum stress
[IZF-1987-24] N89-14692
**PHYSIOLOGICAL EFFECTS**
Effects of calcitonin and retabolil on rat femur in hypokinesia N89-14659
The effect of pyridostigmine bromine on inflight aircrew performance
[AD-A198828] N89-14670
**PHYSIOLOGICAL RESPONSES**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
[AD-A197472] N89-14668
**PHYSIOLOGY**
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-87-008] N89-14658
**PIEZOELECTRIC CERAMICS**
Mechanical reliability of piezoelectric and dielectric ceramics
[AD-A198458] N89-14327
**PILOT PERFORMANCE**
Autonomous RPRV navigation, guidance and control
[NASA-CR-179425] N89-14228
The effect of pyridostigmine bromine on inflight aircrew performance
[AD-A198828] N89-14670
Further investigation of contrast sensitivity and visual acuity in pilot detection of aircraft
[AD-A198434] N89-14680
**PIPES (TUBES)**
Two-bar thermal ratchetting of annealed 2.25Cr-1Mo steel N89-14304
**PISTON ENGINES**
Engines for Mini-RPV XM-1A
[AD-A198336] N89-14236
**PITCHING MOMENTS**
High lift, low pitching moment airfoils
[NASA-CASE-LAR-13215-1] N89-14224
**PLANETARY BOUNDARY LAYER**
Dynamical adjustments in the planetary boundary layer N89-14618
Turbulence structure of Arctic stratus clouds derived from measurements and simulations
[DFVLR-FB-88-29] N89-14633
**PLANETARY EVOLUTION**
Experimental cosmochemistry in the Space Station N89-15002

**PLANETARY IONOSPHERES**
TIROS/NOAA (television and infrared observation satellite/National Oceanic and Atmospheric Administration) satellites space environment monitor archive tape documentation, 1988 update
| PB88-224613 | N89-14619
**PLANETARY STRUCTURE**
Physics of windblown particles N89-15000
**PLANETARY SURFACES**
Planetary impact experimentation N89-14999
Low-gravity impact experiments: Progress toward a facility definition N89-15009
**PLANETOLOGY**
Particle formation and interaction N89-15001
Small linear wind tunnel saltation experiments: Some experiences N89-15015
Low-gravity facilities for Space Station planetology experiments N89-15032
**PLANNING**
Liquid Rocket Booster (LRB) for the Space Transportation System (STS) systems study. Study plan
| NASA-CR-179401 | N89-14249
DEH (Directorates of Engineering and Housing) automated graphics guide: Selection, acquisition, implementation, and management
| AD-A198489 | N89-14721
**PLASMA CONTROL**
Status of fusion research and implications for D/He-3 systems N89-14845
Panel on high beta and/or high field tokamaks and stellarators
| DE88-017367 | N89-14859
**PLASMA DIAGNOSTICS**
A magnetospheric simulation at the Space Station N89-15024
**PLASMA GUNS**
Multilayer plasma coats used as thermal barrier in engines
| ETN-89-93598 | N89-14333
**PLASMA PHYSICS**
Starpower: The US and the international quest for fusion energy, contractor documents
| PB88-214663 | N89-14839
High temperature blankets for non-electrical/electrical applications of fusion reactors
| DE88-017307 | N89-14857
Activities report in plasma physics
| ETN-89-93377 | N89-14864
A magnetospheric simulation at the Space Station N89-15024
**PLASMA PINCH**
The physics of the high density Z-pinch
| DE88-016147 | N89-14855
Toroidal pinch experiments in OHTE with a resistive shell
| DE88-017339 | N89-14858
**PLASMA RADIATION**
HANEX simulations of laser-target interactions: 1. Radiation processes
| AD-A197965 | N89-14438
**PLASMA SPRAYING**
Multilayer plasma coats used as thermal barrier in engines
| ETN-89-93598 | N89-14333
**PLASMA TEMPERATURE**
The effect of torch pressure on analyte response in a 27 MHz inductively coupled plasma
| AD-A198595 | N89-14863
**PLASMAS (PHYSICS)**
Detection of ions by replacement-ion chromatography coupled to a microwave-induced nitrogen discharge at atmospheric pressure
| AD-A198800 | N89-14273
Review projects for the US Fusion Program
| DE88-017306 | N89-14856
**PLASTIC DEFORMATION**
A unified model for predicting the stress and strain distributions around cracks of any length, including elastic, plastic, creep and cyclic deformation N89-14455
**PLASTICS**
The effect of high heating rate on the pyrolysis of polymeric and composite materials
| AD-A198052 | N89-14319
**PLATES (STRUCTURAL MEMBERS)**
Temperature effect on stress concentration around circular hole in a composite material specimen representative of X-29A forward-swept wing aircraft
| NASA-CR-179439 | N89-14456
Response of composite plates subjected to acoustic loading
| NASA-CR-184618 | N89-14469
**PLATES (TECTONICS)**
Homogeneous plate deformation as monitored by Satellite Laser Ranging (SLR) and analyzed using 3D affine transformation models
| B8821604 | N89-14488
**PLATING**
On the use of 1-D finite elements for the temperature behavior of a contoured and partially plated SC-Cut resonator
| AD-A198309 | N89-14882
**PLATINUM**
Solid phase equilibria in the Pt-Ga-As and Pt-Ga-Sb systems
| AD-A198654 | N89-14887
Pretreatment of CO oxidation catalysts N89-14930
**PLOTTING**
Plotting component maps in the Navy/NASA Engine Program (NNEP): A method and its usage
| NASA-TM-101433 | N89-14239
User's guide for executing OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms, version 4) with CBM-4 (Carbon-Bond Mechanism-4)
| PB88-221965 | N89-14609
**POINTING CONTROL SYSTEMS**
Control of the flexible modes of an advanced technology geostationary platform N89-14902
**POISSON DENSITY FUNCTIONS**
The nature of the aircraft component failure process: A working note
| AD-A197979 | N89-14234
On exceedance point processes for stationary sequences under mild oscillation restrictions
| AD-A198314 | N89-14806
**POISSON EQUATION**
The nature of the aircraft component failure process: A working note
| AD-A197979 | N89-14234
**POLAR CAP ABSORPTION**
Near UV atmospheric absorption measurements from the DC-8 aircraft during the 1987 airborne Antarctic ozone experiment N89-14544
**POLAR METEOROLOGY**
Polar Ozone Workshop. Abstracts
| NASA-CP-10014 | N89-14503
The morphology and meteorology of Southern Hemisphere spring total ozone mini-holes N89-14516
Balloon borne Antarctic frost point measurements and their impact on polar stratospheric cloud theories N89-14524
Large-scale variations in ozone and polar stratospheric clouds measured with airborne lidar during formation of the 1987 ozone hole over Antarctica N89-14525
Investigations of the dynamics and thermodynamics of the mesosphere and upper thermosphere at the polar regions
| AD-A198463 | N89-14627
**POLAR REGIONS**
Seasonal and temporal changes in the vertical profiles of polar stratospheric ozone: 1978-1986 N89-14513
On the size and composition of particles in polar stratospheric clouds N89-14528
Formation of polar stratospheric clouds simulated in a two dimensional model of the atmosphere N89-14529
Heterogeneous physicochemistry of the winter polar stratosphere N89-14535
Physical processes in polar stratospheric ice clouds N89-14536
Photochemical trajectory modelling studies of the 1987 Antarctic spring vortex N89-14559
Temporal trends and transport within and around the Antarctic polar vortex during the formation of the 1987 Antarctic ozone hole N89-14565
Transport into the south polar vortex in early spring N89-14567
The evolution of AAOE observed constituents with the polar vortex N89-14568
Variations of total ozone in the north polar region as seen by TOMS N89-14571
Observations of stratospheric source gas profiles during the Arctic winter N89-14573
Rocket- and aircraft-borne trace gas measurements in the winter polar stratosphere N89-14574
Visible and near-ultraviolet spectroscopy at Thule AFB (76.5 N) from January 28 - February 15, 1988 N89-14576
Polar vortex dynamics N89-14588
Theoretical study of polar and global ozone changes using a coupled radiative-dynamical 2-D model N89-14590
Simulation of the transport of halogen species from the equatorial and mid-latitude stratosphere to the polar stratosphere in a two-dimensional model N89-14595
A two-dimensional model of the quasi biennial oscillation of ozone N89-14596
Use of operational analyses to study the dynamics of troposphere-stratosphere interactions in polar regions N89-14597
Studies of ClO and BrO reactions important in the polar stratosphere: Kinetics and mechanism of the ClO + BrO and ClO + ClO reactions N89-14599
Investigations of the dynamics and thermodynamics of the mesosphere and upper thermosphere at the polar regions
| AD-A198463 | N89-14627
Cloud classification from satellite data using a fuzzy sets algorithm: A polar example
| NASA-CR-184568 | N89-14708
**POLARIMETRY**
CCD polarimetry as a probe of regions of recent star-formation N89-15054
**POLARIZATION (WAVES)**
CCD polarimetry as a probe of regions of recent star-formation N89-15054
**POLICIES**
The USL NASA PC R and D development environment standards
| NASA-CR-184535 | N89-14975
**POLITICS**
Starpower: The US and the international quest for fusion energy, contractor documents
| PB88-214663 | N89-14839
**POLYETHYLENE TEREPHTHALATE**
Radiation effects on polymeric materials N89-14914
**POLYGONS**
Polygons, stars, and clusters: An investigation of polygon displays
| AD-A198430 | N89-14719
**POLYIMIDES**
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
| NASA-CR-181724 | N89-14896
Semi-interpenetrating polymer network's of polyimides: Fracture toughness N89-14912
Polymer powder prepregging: Scoping study N89-14926
**POLYMER CHEMISTRY**
Rheological studies on blends of rodlike and flexible chain polymers
| AD-A198455 | N89-14326
**POLYMERIZATION**
Graphite fluoride fiber polymer composite material
| NASA-CASE-LEW-14472-1 | N89-14259
Durability of adhesive joints: An engineering study
| PB88-233473 | N89-14307
Block interrupt polysilane derivatives
| AD-A198804 | N89-14312
A synthetic route to organic aerogels: Mechanism, structure, and properties
| DE88-017112 | N89-14317
Condensation polymers with controlled structure
| AD-A198086 | N89-14321
Synthesis of energetic single phase and multi-phase polymers
| AD-A198431 | N89-14325
Polysilylated unsaturated molecules
| AD-A198492 | N89-14328
Computer modeling of polymers N89-14910
The effects of atomic oxygen on polymeric materials N89-14921
**POLYNOMIALS**
Computation of algebraic polynomial parametric surface intersections
| PB88-208277 | N89-14778
Generalized Eigenvalues for pairs on heritian matrices N89-14923
**POLYPHENYLS**
Polyphenylquinoxalines containing alkylenedioxy groups
| NASA-CASE-LAR-13601-1-CU | N89-14337
**POLYQUINOXALINES**
Polyphenylquinoxalines containing alkylenedioxy groups
| NASA-CASE-LAR-13601-1-CU | N89-14337
**POLYSTYRENE**
Composite foams
| DE89-000368 | N89-14315
**POROSITY**
Measurement and prediction of mass transfer in solid catalysts N89-14267
**POSITION (LOCATION)**
NAVSPASUR system performance analysis
| AD-A198848 | N89-14252
Controlled sample orientation and rotation in an acoustic levitator
| NASA-CASE-NPO-17086-1-CU | N89-14422
Extension and validation of a method for locating damaged members in large space trusses N89-14925
**POSITION INDICATORS**
Legislated emergency locating transmitters and emergency position indicating radio beacons
| NASA-CASE-GSC-12892-1 | N89-14374
**POSTFLIGHT ANALYSIS**
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
| NASA-TM-100459-VOL-1 | N89-14331

Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
| NASA-TM-100459-VOL-2 | N89-14332
**POTENTIOMETRIC ANALYSIS**
Electrochemical studies of molten glass N89-14266
**POWDER (PARTICLES)**
Polymer powder prepregging: Scoping study N89-14926
**POWER EFFICIENCY**
The effect of transmission design on force-controlled manipulator performance
| AD-A198131 | N89-14689
**POWER LINES**
Magnetic and electric field meters developed for the US Department of Energy
| NASA-CR-184628 | N89-14421
**PRECIPITATION (METEOROLOGY)**
The data collection component of the Hanford Meteorology Monitoring Program
| DE89-000404 | N89-14641
**PRECISION**
Precision of line following in digital images
| B8821610 | N89-14486
**PREDICTION ANALYSIS TECHNIQUES**
Two-bar thermal ratchetting of annealed 2.25Cr-1Mo steel N89-14304
The role of horizontal processes in upper-ocean prediction: A forecast simulation in the Sea of Japan
| AD-A198827 | N89-14654
A split-Levinson approach to autoregressive modeling
| AD-A198535 | N89-14722
**PREDICTIONS**
Leakage predictions for Rayleigh-step, helium-purge seals
| NASA-TM-101352 | N89-14255
Progress and prospects in soft X-ray holographic microscopy
| DE88-016638 | N89-14409
The role of thermal and lubricant boundary layers in the transient thermal analysis of spur gears
| NASA-TM-101435 | N89-14452
An investigation of turbulence models N89-14905
Modeling of transitional flows N89-14917
**PREPREGS**
Statistical characterization of carbon phenolic prepreg materials, volume 1
| NASA-CR-179416 | N89-14306
Polymer powder prepregging: Scoping study N89-14926
**PRESSURE DRAG**
Dynamic stall computations using a zonal Navier-Stokes model
| AD-A197942 | N89-14397
**PRESSURE EFFECTS**
Aerodynamic and kinetic processes in flames
| AD-A198474 | N89-14284
The effect of torch pressure on analyte response in a 27 MHz inductively coupled plasma
| AD-A198595 | N89-14863
Crystal-liquid-vapor equilibrium experiments at high temperature (less than or equal to 1800 C) and low, controlled oxygen and hydrogen pressure (10(-1) to 10(-9) PA) N89-15028
**PRESSURE MEASUREMENT**
Pressure measuring probe
| NASA-CASE-LAR-13853-1 | N89-14423
**PRESSURE RATIO**
Advanced core technology: Key to subsonic propulsion benefits
| NASA-TM-101420 | N89-14237
**PRESSURE SENSORS**
Circumferential pressure probe
| NASA-CASE-LAR-13775-1 | N89-14408
Pressure measuring probe
| NASA-CASE-LAR-13853-1 | N89-14423
**PRESSURE VESSELS**
Two-bar thermal ratchetting of annealed 2.25Cr-1Mo steel N89-14304
**PRESSURIZING**
Discussion and explanation of unplanned ignition incident: Ignition caused by rapid pressurization of a propellant containing bubbles
| AD-A198419 | N89-14340
**PRETREATMENT**
Pretreatment of CO oxidation catalysts N89-14930
**PRIMARY COSMIC RAYS**
Modelling of central density spectra of extensive air showers from primary particles with E = 10(sup 2)-10(sup 7) GeV
| DE88-703728 | N89-15069
**PRIMERS (COATINGS)**
Influence of the application parameters of primer coats for bonding. Test report 49-064/F
| REPT-49-064/F | N89-14336
**PRINTING**
LARCMACS: A TEX macro set for typesetting NASA reports
| NASA-TM-101522 | N89-14994
**PROBLEM SOLVING**
On the connection of digitized maps to a uniform coordinate system. A special case of the geodetic connection problem
| B8821602 | N89-14487
Research instrumentation for computer vision, image understanding and optical computing
| AD-A198578 | N89-14723
Decomposition strategies for eliciting expert knowledge: Judgements of dangerousness
| AD-A197913 | N89-14936
Knowledge based systems: A preliminary survey of selected issues and techniques
| NASA-CR-184513 | N89-14953
**PROCEDURES**
The USL NASA PC R and D project: General specifications of objectives
| NASA-CR-184534 | N89-14974
The USL NASA PC R and D development environment standards
| NASA-CR-184535 | N89-14975
**PROCESS CONTROL (INDUSTRY)**
Introduction of the Proceedings of the Tenth Symposium on Biotechnology for Fuels and Chemicals
| DE88-016361 | N89-14667
Expert system on a chip: An engine for real-time approximate reasoning N89-14771
Polymer powder prepregging: Scoping study N89-14926
**PROCUREMENT**
PROMIS (Procurement Management Information System)
| NASA-CR-179395 | N89-14933
The USL NASA PC R and D project: General specifications of objectives
| NASA-CR-184534 | N89-14974
**PRODUCT DEVELOPMENT**
RADC (Rome Air Development Center) system/software requirements engineering testbed research and development program
| AD-A197858 | N89-14711
**PRODUCTION ENGINEERING**
Lunar hydrogen: A resource for future use at lunar bases and space activities N89-14847
**PRODUCTIVITY**
The influence of grazing on land surface climatological variables
| NASA-CR-183308 | N89-14637
DEH (Directorates of Engineering and Housing) automated graphics guide: Selection, acquisition, implementation, and management
| AD-A198489 | N89-14721
**PROGRESS**
Progress and prospects in soft X-ray holographic microscopy
| DE88-016638 | N89-14409
**PROGRESSIONS**
Antenna arrays with increasing according to arithmetical progression distances between the emitters
| AD-A198644 | N89-14366
**PROJECT MANAGEMENT**
Geologic mapping in the US Geological Survey
| PB88-223870 | N89-14477
**PROJECTILES**
Ultra-high velocity, HE-driven projectile launchers
| DE88-015429 | N89-14246
**PROPELLANT BINDERS**
Synthesis of energetic single phase and multi-phase polymers
| AD-A198431 | N89-14325
**PROPELLANTS**
A preliminary report on developing an expert system for computer-aided formulation of propellants
| AD-A198088 | N89-14339
**PROPELLERS**
High lift, low pitching moment airfoils
| NASA-CASE-LAR-13215-1 | N89-14224
Parametric studies of advanced turboprops
| NASA-TM-101389 | N89-14465
Users' manual for the Langley high speed propeller noise prediction program (DFP-ATP)
| NASA-CR-4208 | N89-14820
**PROTECTIVE CLOTHING**
Working in impermeable clothing: Criteria for maximum stress
| IZF-1987-24 | N89-14692
**PROTECTIVE COATINGS**
Tribological characteristics of coatings on aluminium and its alloys N89-14290
Influence of the application parameters of primer coats for bonding. Test report 49-064/F
| REPT-49-064/F | N89-14336
**PROTOCOL (COMPUTERS)**
The design and protocol of a summertime rainfall enhancement program for West Texas N89-14636
The use of think aloud verbal protocols for the identification of mental models
| DE88-015180 | N89-14935
**PROTON BEAMS**
Electromagnetic time-domain calculations in two and three dimensions
| DE89-000311 | N89-14355
**PROTONS**
The surface enhanced raman scattering of the protonated forms of DABCO at a silver electrode
| AD-A197930 | N89-14278
**PROTOPLANETS**
Debris-cloud collisions: Accretion studies in the Space Station N89-15033
**PROTOTYPES**
Development of an endoscopic probe for radial metrology
| NASA-CR-184577 | N89-14417
Synthesis of graphical displays for tabular data
| AD-A198979 | N89-14707
**PROVING**
Extension and validation of a method for locating damaged members in large space trusses N89-14925
**PROXIMITY EFFECT (ELECTRICITY)**
Josephson junction arrays with positional disorder: Experiments and simulations N89-14867
**PSYCHIATRY**
An inquiry into panic and its differentiation from other types of anxiety N89-14679
**PSYCHOLOGICAL EFFECTS**
Influence of emotional-pain stress on contractile function of myocardium during long-term hypokinesia N89-14662
**PUBLIC HEALTH**
Assessing the risks of trace gases that can modify the stratosphere. Volume 1: Executive summary
| PB88-231055 | N89-14610
**PULSE HEATING**
Development of a rotary valve for pulse combustion applications
| PB88-250568 | N89-14444
**PULSED LASERS**
HANEX simulations of laser-target interactions: 1. Radiation processes
| AD-A197965 | N89-14438
**PULSES**
Chirped pulse amplification: Present and future
| DE89-001016 | N89-14434
Adaptable pulsed analog-to-digital converter
| DE88-703778 | N89-14701
**PUMPS**
Ozone profile measurements at McMurdo Station Antarctica during the spring of 1987 N89-14514
**PURGING**
Leakage predictions for Rayleigh-step, helium-purge seals
| NASA-TM-101352 | N89-14255
**PYRIDINES**
The effect of pyridostigmine bromine on inflight aircrew performance
| AD-A198828 | N89-14670
**PYROLYSIS**
The effect of high heating rate on the pyrolysis of polymeric and composite materials
| AD-A198052 | N89-14319
**PYROMETERS**
Multicolor pyrometer for materials processing in space, phase 2
| NASA-CR-183358 | N89-14406

## Q

**Q FACTORS**
Finite element formulation for nonlinear viscoplastic material using a Q-model
| PB88-213764 | N89-14776
**QUADRATIC EQUATIONS**
Analogs of Clifford algebra for forms above quadratic and their matrix realization
| DE88-703748 | N89-14787
**QUADRATIC PROGRAMMING**
A software package for sequential quadratic programming
| DFVLR-FB-28-28 | N89-14731
**QUALITY CONTROL**
Ceramics: Materials for severe environments
| PB88-240049 | N89-14308
Nonparametric estimation of optimal performance criteria in quality engineering
| AD-A198315 | N89-14807

**QUANTITATIVE ANALYSIS**
Trace analysis by capillary gas chromatography: Theory and methods
| B8811770 | N89-14289
Quantitative observations of the behavior of anomalous low altitude ClO in the Antarctic spring Stratosphere, 1987 N89-14548
**QUANTUM EFFICIENCY**
Comparison of charge transfer device and photomultiplier tube performance for extremely low photon fluxes
| AD-A198594 | N89-14382
**QUANTUM ELECTRODYNAMICS**
Fundamental quantum 1/F noise in ultrasmall semiconductor devices and their optimal design principles
| AD-A198462 | N89-14381
**QUANTUM MECHANICS**
Collision phenomena in a quantum gas
| B8811778 | N89-14829
Dynamics of observed reality: Abridged version of classical and quantum mechanics
| AD-A198637 | N89-14894
**QUANTUM THEORY**
Collision phenomena in a quantum gas
| B8811778 | N89-14829
Dynamics of observed reality: Abridged version of classical and quantum mechanics
| AD-A198637 | N89-14894
**QUARTZ**
On the use of 1-D finite elements for the temperature behavior of a contoured and partially plated SC-Cut resonator
| AD-A198309 | N89-14882
**QUASARS**
Evolution of photon and particle spectra in compact, luminous objects
| NASA-TM-101247 | N89-14825
Optical spectroscopy of X-ray: Selected active galactic nuclei N89-15049
**QUERY LANGUAGES**
Concepts and implementations of natural language query systems
| NASA-CR-184514 | N89-14954
Natural language query system design for interactive information storage and retrieval systems
| NASA-CR-184525 | N89-14965
Natural language query system design for interactive information storage and retrieval systems. Presentation visuals
| NASA-CR-184526 | N89-14966
KARL: A Knowledge-Assisted Retrieval Language
| NASA-CR-184529 | N89-14969
**QUEUEING THEORY**
Queuing network models and performance analysis of computer systems
| B8811769 | N89-14738

## R

**RABBITS**
Correction of acute hypoxia-induced changes in blood coagulation in rabbits N89-14663
**RADAR**
Transverter assembly for the advanced instrumentation radar
| DE89-001036 | N89-14357
**RADAR APPROACH CONTROL**
Precision approach radars Twenthe and Volkel (Netherlands). Multipath propagation problems
| FEL-1988-15 | N89-14372
**RADAR CORNER REFLECTORS**
Radar Cross Section (RCS) reduction techniques for square trihedral corner reflectors at 35 GHz: Measurements and theoretical simulations
| FEL-1988-04 | N89-14365
**RADAR CROSS SECTIONS**
Numerical methods to solve the problem of scattering from electrically large bodies
| AD-A198098 | N89-14359
Radar Cross Section (RCS) reduction techniques for square trihedral corner reflectors at 35 GHz: Measurements and theoretical simulations
| FEL-1988-04 | N89-14365
**RADAR ECHOES**
Investigation of radar backscattering from second-year sea ice
| NASA-CR-180986 | N89-14479
**RADAR IMAGERY**
The design and protocol of a summertime rainfall enhancement program for West Texas N89-14636
Mapping experiment with space station N89-15046
**RADAR MEASUREMENT**
Large-scale variations in ozone and polar stratospheric clouds measured with airborne lidar during formation of the 1987 ozone hole over Antarctica N89-14525
**RADAR SCATTERING**
Specular reflection coefficient of snow at 10, 35 and 94 GHz as a function of grazing angle (Oberjettenberg-Campaign)
| FEL-1988-01 | N89-14495
**RADIAL DISTRIBUTION**
Development of an endoscopic probe for radial metrology
| NASA-CR-184577 | N89-14417
**RADIANCE**
Daylight and twilight sky radiance and terrestrial irradiance
| AD-A198550 | N89-14628
Summary of along-track data from the earth radiation budget satellite for several representative ocean regions
| NASA-RP-1206 | N89-14634
**RADIANT COOLING**
Liquid sheet radiator apparatus
| NASA-CASE-LEW-14295-1 | N89-14348
**RADIATION ABSORPTION**
Radiative aspects of Antarctic ozone hole in 1985 N89-14592
**RADIATION COUNTERS**
Automation of a Guinier camera for X-ray diffraction
| ETN-89-93350 | N89-14419
**RADIATION DAMAGE**
Mechanisms of radiation damage generated by ionizing radiation in optical waveguides
| AD-A198030 | N89-14834
Benchmark solutions for the galactic ion transport equations with spatial and energy coupling N89-14907
**RADIATION DOSAGE**
Radiation sensitivity of soluble polysilane derivatives: Science and applications
| AD-A198805 | N89-14313
**RADIATION EFFECTS**
Stability of bulk Ba2YCu3O(7-x) in a variety of environments
| NASA-TM-101401 | N89-14310
Radiation sensitivity of soluble polysilane derivatives: Science and applications
| AD-A198805 | N89-14313
ELF (Extremely Low Frequency) communication system ecological monitoring program: Electromagnetic field measurements and engineering support, 1987
| AD-A198303 | N89-14360
Assessing the risks of trace gases that can modify the stratosphere. Volume 6: Technical support documentation production projections
| PB88-231071 | N89-14611
Assessing the risks of trace gases that can modify the stratosphere. Volume 7: Technical support documentation atmospheric science papers
| PB88-231089 | N89-14612
Assessing the risks of trace gases that can modify the stratosphere. Volume 8: Technical support documentation ozone depletion and plants
| PB88-231097 | N89-14613
Radiation-induced transient absorption in single mode optical fibers
| DE89-000392 | N89-14832
Application of linear response theory to experimental data of simultaneous radiation and annealing response of a CMOS device
| NASA-CR-183401 | N89-14871
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
| NASA-CR-181724 | N89-14896
Effects of electron irradiation on high temperature superconductors and contacts to high temperature superconductors N89-14900
Radiation effects on polymeric materials N89-14914
Preliminary estimates of galactic cosmic ray shielding requirements for manned interplanetary missions
| NASA-TM-101516 | N89-15070
**RADIATION MEASUREMENT**
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
| AD-A198656 | N89-14367
**RADIATION MEASURING INSTRUMENTS**
A new method for trace metal determinations by monitoring modulated magnetically induced optical rotation in atomic vapours
| AD-A198799 | N89-14272
**RADIATION SHIELDING**
Consideration of ionizing radiation shielding for optical fibers
| PB88-237029 | N89-14817
Preliminary estimates of galactic cosmic ray shielding requirements for manned interplanetary missions
| NASA-TM-101516 | N89-15070
**RADIATIVE TRANSFER**
HANEX simulations of laser-target interactions: 1. Radiation processes
| AD-A197965 | N89-14438
Theoretical study of polar and global ozone changes using a coupled radiative-dynamical 2-D model N89-14590
Radiative aspects of Antarctic ozone hole in 1985 N89-14592
Determination of soil moisture beneath a stalk or trunk dominated canopy
| NASA-CR-183322 | N89-14621
Determination of optical properties by inversion of multiple scattering data: Experimental program
| AD-A198518 | N89-14837
Pair production and annihilation in gamma-ray bursts N89-15065
**RADICALS**
High resolution FTIR spectroscopy of the ClO radical N89-14607
**RADIO BEACONS**
Legislated emergency locating transmitters and emergency position indicating radio beacons
| NASA-CASE-GSC-12892-1 | N89-14374
**RADIO FREQUENCY DISCHARGE**
Modeling of RF plasmas in a parallel plate etch reactor
| B8811775 | N89-14865
**RADIOACTIVE DECAY**
Low activation materials for fusion
| DE88-015561 | N89-14854
**RADIOSONDES**
NMC stratospheric analyses during the 1987 Antarctic expedition N89-14511
The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
Ozone profile measurements at McMurdo Station Antarctica during the spring of 1987 N89-14514
**RADIUM**
An intercomparison of the radium mass standards of the UK and the USSR
| NPL-RS(EXT)-103 | N89-14828
**RAIN**
The design and protocol of a summertime rainfall enhancement program for West Texas N89-14636
**RAMAN LASERS**
Influence of the A.C. Stark effect on stimulated hyper-Raman profiles in sodium vapor
| DE88-015557 | N89-14429
**RAMAN SPECTRA**
The surface enhanced raman scattering of the protonated forms of DABCO at a silver electrode
| AD-A197930 | N89-14278
Vibration spectra of silica near 2400 K: Measurement and molecular dynamics simulation
| DE88-015925 | N89-14314
**RAMAN SPECTROSCOPY**
The surface enhanced raman scattering of the protonated forms of DABCO at a silver electrode
| AD-A197930 | N89-14278
**RAMJET ENGINES**
Fire extinguishing agent evaluation in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS)
| AD-A198523 | N89-14227
**RANDOM ACCESS MEMORY**
Random access algorithms for multiuser computer communication networks
| AD-A198090 | N89-14713
**RANDOM LOADS**
Response of composite plates subjected to acoustic loading
| NASA-CR-184618 | N89-14469
**RANDOM NUMBERS**
Generation of an ordered simple random sample without replacement using one random number
| DE89-001341 | N89-14785
**RANDOM SAMPLING**
Generation of an ordered simple random sample without replacement using one random number
| DE89-001341 | N89-14785
**RANGE AND RANGE RATE TRACKING**
Simulation and analysis of a Geopotential Research Mission N89-14478
**RATES (PER TIME)**
The determination of energy transfer rates in the Ho:Tm:Cr:YAG laser material N89-14915
Transient heat transfer from shrinking LOX-drop N89-14916
**RATS**
Effects of calcitonin and retabolil on rat femur in hypokinesia N89-14659
Influence of high temperature on total gas metabolism of animals with limitation of motor activity N89-14661

**RAYLEIGH DISTRIBUTION**
Leakage predictions for Rayleigh-step, helium-purge seals
[NASA-TM-101352] N89-14255
**REACTION KINETICS**
Aerodynamic and kinetic processes in flames
[AD-A198474] N89-14284
A synthetic route to organic aerogels: Mechanism, structure, and properties
[DE88-017112] N89-14317
Effect of heat release on the spatial stability of a supersonic reacting mixing layer
[NASA-CR-181753] N89-14402
**REACTOR DESIGN**
Status of fusion research and implications for D/He-3 systems N89-14845
**REACTOR SAFETY**
Helium-3 blankets for tritium breeding in fusion reactors N89-14844
Low activation materials for fusion
[DE88-015561] N89-14854
**REACTOR TECHNOLOGY**
Strategy for D/He-3 fusion development N89-14846
Review projects for the US Fusion Program
[DE88-017306] N89-14856
**READ-ONLY MEMORY DEVICES**
CD-ROM (Compact Disc Read Only Memory) library of the future
[AD-A197943] N89-14702
**REAL TIME OPERATION**
Development and use of interactive displays in real-time ground support research facilities
[NASA-TM-101694] N89-14683
Running a large Monte Carlo Program in a farm of MicroVAX-II computers under VAXELIN
[DE88-012761] N89-14732
Expert system on a chip: An engine for real-time approximate reasoning N89-14771
**RECORDING**
High speed data acquisition systems
[AD-A198194] N89-14735
**RED SHIFT**
Magnetic properties of C 4 Doppler shift patterns
[AD-A198602] N89-15062
**REDUCED GRAVITY**
Effects of crucible wetting during solidification of immiscible Pb-Zn
[NASA-TM-101372] N89-14341
Particle formation and interaction N89-15001
Impact cratering in reduced-gravity environments: Early experiments on the NASA KC-135 aircraft N89-15008
Low-gravity impact experiments: Progress toward a facility definition N89-15009
Volatilization-devolatilization reactions N89-15014
Impact experimentation and the microgravity environment: An overview N89-15016
Exobiology experiment concepts for Space Station N89-15017
Experimental studies of crystal-melt differentiation in planetary basalt compositions N89-15018
Dynamic crystallization experiments on chondrule melts in reduced gravity N89-15023
Cautionary tales for reduced-gravity particle research N89-15026
Nucleation and particle coagulation experiments in microgravity N89-15030
Textural evolution of partially-molten planetary materials in microgravity N89-15037
Grain dynamics in zero gravity N89-15038
Experimental constraints on the origin of chondrules N89-15043
Containerless high-pressure petrology experiments in the microgravity environment of the Space Station N89-15045
Microgravity research in NASA ground-based facilities
[NASA-TM-101397] N89-15047
**REDUCTION**
Method and apparatus for reducing speckle
[NASA-CASE-LAR-13771-1] N89-14428
**REDUCTION (CHEMISTRY)**
Electrochemical studies of molten glass N89-14266
Powerful photogenerated reducing agents
[AD-A197949] N89-14279
**REFINING**
Numbering of new elements for net refinement
[NASA-TT-20435] N89-14737
**REFLECTANCE**
Specular reflection coefficient of snow at 10, 35 and 94 GHz as a function of grazing angle (Oberjettenberg-Campaign)
[FEL-1988-01] N89-14495
**REFLECTION NEBULAE**
CCD polarimetry as a probe of regions of recent star-formation N89-15054
**REFLECTOMETERS**
Automated data acquisition and processing for a Hohlraum reflectometer
[NASA-TM-101393] N89-14416
**REFLEXES**
Studies of the horizontal vestibulo-ocular reflex on STS 7 and 8
[NASA-TM-100468] N89-14677
**REFRACTIVITY**
The precise determination of the refractive index of air
[NPL-MOM-90] N89-14629
**REFRIGERATORS**
Joule Thomson refrigerator
[NASA-CASE-NPO-17143-1-CU] N89-14351
**REGOLITH**
Lunar Helium-3 and Fusion Power
[NASA-CP-10018] N89-14842
Processes and energy costs for mining lunar Helium-3 N89-14848
**REGRESSION ANALYSIS**
A note on second order effects in a semiparametric context
[AD-A198018] N89-14804
**RELATIVISTIC EFFECTS**
Very Long Baseline Interferometry (VLBI): Relativity and geodesy
[ETN-89-93337] N89-14493
**RELATIVITY**
Laser clocks and near field gravity of rotating objects N89-14911
**RELIABILITY**
Mechanical reliability of piezoelectric and dielectric ceramics
[AD-A198458] N89-14327
NASA PC software evaluation project
[NASA-CR-184550] N89-14990
**REMOTE CONSOLES**
PC-based Multiple Information System Interface (PC/MISI) design plan
[NASA-CR-184547] N89-14987
**REMOTE HANDLING**
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems
[NASA-CR-184523] N89-14963
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems. Presentation visuals
[NASA-CR-184524] N89-14964
**REMOTE SENSING**
Remote sensing information sciences research group
[NASA-CR-183374] N89-14481
An FTIR spectrometer for remote measurements of atmospheric composition N89-14550
Mixing ratios of trace gases in the austral polar atmosphere during August and September of 1987 N89-14556
**REMOTE SENSORS**
The detection and study of molecular species using time resolved laser spectroscopy
[AD-A198482] N89-14285
**REMOTELY PILOTED VEHICLES**
Autonomous RPRV navigation, guidance and control
[NASA-CR-179425] N89-14228
Engines for Mini-RPV XM-1A
[AD-A198336] N89-14236
**REPETITION**
Spacing effects in learning described by the SAM model. Comparing three versions of the SAM model
[PB88-204060] N89-14678
**REPLACING**
Generation of an ordered simple random sample without replacement using one random number
[DE89-001341] N89-14785
**REPORTS**
Center for Electronics and Electrical Engineering technical progress bulletin covering Center programs, October to December 1987 with 1988 CEEE events calendar
[PB88-232913] N89-14375
Distributed diagnostic performance reporting and analysis N89-14762
Mathematical sciences: Some research trends
[PB88-232798] N89-14779
**REQUIREMENTS**
RADC (Rome Air Development Center) system/software requirements engineering testbed research and development program
[AD-A197858] N89-14711
Report on OTHER proposals for SSPEX N89-15003
Multi-object astronomical spectroscopy with optical fibres N89-15048
**RESEARCH**
Mathematical sciences: Some research trends
[PB88-232798] N89-14779
**RESEARCH AIRCRAFT**
Temperature and horizontal wind measurements on the ER-2 aircraft during the 1987 airborne Antarctic ozone experiment N89-14560
The meteorological measurement system on the NASA ER-2 aircraft N89-14562
The evolution of AAOE observed constituents with the polar vortex N89-14568
**RESEARCH AND DEVELOPMENT**
Program solicitation closing date: July 22, 1988
[NASA-TM-101217] N89-14934
Overview of the NASA/RECON educational, research, and development activities of the Computer Science Departments of the University of Southwestern Louisiana and Southern University
[NASA-CR-184509] N89-14949
A report on the USL NASA/RECON project. Part 2: PC-based R and D in support of IS and R applications
[NASA-CR-184516] N89-14956
Report on OTHER proposals for SSPEX N89-15003
**RESEARCH FACILITIES**
Equipment to upgrade the facilities of the IIT (Illinois Institute of Technology) Fluid Dynamics Research Center
[AD-A198084] N89-14242
Touchstone for success: The Materials and Process Laboratories
[ESA-BR-52] N89-14244
Power systems facility
[NASA-TM-101447] N89-14247
Welcome to Ames Research Center (1987 forum on Federal technology transfer)
[NASA-TM-100088] N89-14995
Microgravity research in NASA ground-based facilities
[NASA-TM-101397] N89-15047
**RESEARCH MANAGEMENT**
Solid state research
[NASA-CR-183328] N89-14342
Monolithic two-dimensional surface-emitting arrays of GaAs/AlGaAs diode lasers N89-14343
IMAT (Integrated Multidisciplinary Analysis Tool) user's guide for the VAX/VMS computer
[NASA-TM-101500] N89-14475
Research conducted at the Institute for Computer Applications in Science and Engineering in applied mathematics, numerical analysis and computer science
[NASA-CR-181757] N89-14694
A survey of the state-of-the-art and focused research in range systems
[NASA-CR-184595] N89-14726
Artificial intelligence in test program development N89-14769
**RESEARCH PROJECTS**
Summaries of the FY88 applied mathematical sciences research program
[DE89-000242] N89-14784
**RESINS**
Statistical characterization of carbon phenolic prepreg materials, volume 1
[NASA-CR-179416] N89-14306
**RESISTANCE**
Advanced concepts for contaminant resistant fuel cells
[DE88-017151] N89-14496
**RESISTORS**
Cryogenic thermometers based on TVO type resistors and their application
[DE88-703755] N89-14413
**RESONANCE**
Phase transformation and enhanced nuclear resonance in acoustics N89-14816
Long-lived resonance states in Si-doped AlGaAs
[DE89-000305] N89-14879
**RESONANT FREQUENCIES**
Transverse effects of a waveguide coupling slot
[DE89-000340] N89-14356
**RESONATORS**
On the use of 1-D finite elements for the temperature behavior of a contoured and partially plated SC-Cut resonator
[AD-A198309] N89-14882
**RESOURCES**
Chemical variability in ocean frontal areas
[AD-A198418] N89-14655
**RESPIRATION**
Progress in lung modeling by the ICRP task group
[DE88-015934] N89-14671
**REVERSE FIELD PINCH**
Toroidal pinch experiments in OHTE with a resistive shell
[DE88-017339] N89-14858
Edge-plasmas and wall protection in RFPs (Reversed-Field Pinch)
[DE89-000386] N89-14860

Technology and physics implications of oscillating-field current drive in reversed-field pinches
[DE89-000388] N89-14861

**REVERSED FLOW**
Thrust-reverser flow investigation on a twin-engine transport
[NASA-TP-2856] N89-14213

**REYNOLDS EQUATION**
An investigation into fluid film lubrication in dynamically loaded bearings N89-14442

**REYNOLDS NUMBER**
A finite difference analysis of the heat transfer in periodic cavity flows N89-14389

**RHEOLOGY**
Rheological and rheo-optical studies with nematogenic solutions of a rodlike polymer: A review of data on poly(phenylene benzobisthiazole)
[AD-A197994] N89-14318
Rheological studies on blends of rodlike and flexible chain polymers
[AD-A198455] N89-14326

**RICCATI EQUATION**
On Hilbert-Schmidt norm convergence of Galerkin approximation for operator Riccati equations
[NASA-CR-181755] N89-14798

**RIGID ROTORS**
Calculation of the steadily periodic and gust responses of a hingeless rotor helicopter using two-dimensional time domain unsteady aerodynamics N89-14240

**RING LASERS**
Synchronously pumped mode-locked Ti:Al2O3 lasers N89-14344

**RING STRUCTURES**
Optical fiber data transfer system
[NASA-CR-181704] N89-14376

**RINGS (MATHEMATICS)**
Analysis of FDDI synchronous traffic delays
[NASA-CR-183223] N89-14695

**ROBOTICS**
Light weight high performance manipulators
[AD-A198647] N89-14448
End-effector - joint conjugates for robotic assembly of large truss structures in space: A second generation N89-14898
Experiments in Planetary and Related Sciences and the Space Station
[NASA-CP-2494] N89-14998
An overview of the program to place advanced automation and robotics on the Space Station N89-15004

**ROBOTS**
Influence of the application parameters of primer coats for bonding. Test report 49-064/F
[REPT-49-064/F] N89-14336
Design of an obstacle avoidance system for AIMS
[DE88-016783] N89-14446
Man-robot symbiosis: A framework for cooperative intelligence and control
[DE89-000430] N89-14687

**ROBUSTNESS (MATHEMATICS)**
Robustness of marginal maximum likelihood estimation in the Rasch model
[PB88-209374] N89-14801

**ROCKET ENGINES**
Orbit transfer rocket engine technology program: Oxygen materials compatibility testing
[NASA-CR-182195] N89-14256

**ROCKET-BORNE INSTRUMENTS**
Rocket- and aircraft-borne trace gas measurements in the winter polar stratosphere N89-14574

**RODS**
Rheological studies on blends of rodlike and flexible chain polymers
[AD-A198455] N89-14326

**ROTARY WING AIRCRAFT**
Two-dimensional aerodynamic characteristics of the OLS/TAAT airfoil
[NASA-TM-89435] N89-14216
High lift, low pitching moment airfoils
[NASA-CASE-LAR-13215-1] N89-14224

**ROTATING BODIES**
Development of a rotary valve for pulse combustion applications
[PB88-250568] N89-14444

**ROTATION**
Controlled sample orientation and rotation in an acoustic levitator
[NASA-CASE-NPO-17086-1-CU] N89-14422

**ROTOR AERODYNAMICS**
Dynamic analysis of nonlinear rotor-housing systems
[NASA-CR-184611] N89-14449

**ROTOR BLADES (TURBOMACHINERY)**
Optical fiber data transfer system
[NASA-CR-181704] N89-14376

**ROTORS**
Two-dimensional aerodynamic characteristics of the OLS/TAAT airfoil
[NASA-TM-89435] N89-14216
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight
[NASA-CR-4212] N89-14821

**RUBBER**
Durability of adhesive joints: An engineering study
[PB88-233473] N89-14307

**RUN TIME (COMPUTERS)**
Running a large Monte Carlo Program in a farm of MicroVAX-II computers under VAXELIN
[DE88-012761] N89-14732
Parallel processing techniques for the simulation of MOS VLSI circuits using waveform relaxation
[AD-A197879] N89-14734


## S


**S WAVES**
Holographic recording of deformation waves in muscle tissue N89-14660

**SAFETY**
Evaluation of the improved OV-1D anti-icing system
[AD-A198438] N89-14225

**SAMPLING**
Cosmic dust collection with a sub satellite tethered to a Space Station N89-15010

**SATELLITE COMMUNICATION**
Geolocation via satellite: A methodology and error analysis
[AD-A197955] N89-14253
Assessment of satellite communications quality study. Addendum 1: Impact of propagation delay on data transmission
[NASA-CR-182229] N89-14369

**SATELLITE IMAGERY**
Remote sensing technologies and spatial data applications
[AD-A195809] N89-14480
Space shuttle large format camera photography cloud cover interference diagrams
[PB88-244405] N89-14482
Classification and analysis of surface and clouds at high latitudes from AVHRR multispectral satellite data N89-14635
The design and protocol of a summertime rainfall enhancement program for West Texas N89-14636
Cloud classification from satellite data using a fuzzy sets algorithm: A polar example
[NASA-CR-184568] N89-14708

**SATELLITE OBSERVATION**
ESA's activities report
[ISSN-0258-025X] N89-14937

**SATELLITE ORBITS**
Geolocation via satellite: A methodology and error analysis
[AD-A197955] N89-14253

**SATELLITE ORIENTATION**
NAVSPASUR system performance analysis
[AD-A198848] N89-14252

**SATELLITE TRANSMISSION**
Assessment of satellite communications quality study. Addendum 1: Impact of propagation delay on data transmission
[NASA-CR-182229] N89-14369

**SATELLITE-BORNE INSTRUMENTS**
Control of the flexible modes of an advanced technology geostationary platform N89-14902

**SCALE (RATIO)**
Small scale structure and mixing at the edge of the Antarctic vortex N89-14566

**SCANNING**
Possible measurement errors in calibrated AVHRR (Advanced Very High Resolution Radiometer) data
[AD-A198342] N89-14414

**SCHEDULES**
Liquid Rocket Booster (LRB) for the Space Transportation System (STS) systems study. Study plan
[NASA-CR-179401] N89-14249

**SCHEDULING**
The USL NASA PC R and D development environment standards
[NASA-CR-184535] N89-14975

**SCHOOLS**
Living in space
[EP-222] N89-14684
Curriculum in aerospace science and technology in cooperation with NASA Langley Research Center N89-14908

**SCHROEDINGER EQUATION**
Finite-difference methods for solution of the many-dimensional nonlinear Schroedinger equation
[DE88-703772] N89-14788

**SCIENTISTS**
Transportable educational programs for scientific and technical professionals: More effective utilization of automated scientific and technical data base systems
[NASA-CR-184507] N89-14947
NASA RECON: Course development, administration, and evaluation. A research and development proposal
[NASA-CR-184510] N89-14950
Transportable, university-level educational programs in interactive information storage and retrieval systems
[NASA-CR-184511] N89-14951
A report on the USL NASA/RECON project. Part 1: The development of a transportable, university level, IS and R educational program
[NASA-CR-184515] N89-14955

**SEA ICE**
Investigation of radar backscattering from second-year sea ice
[NASA-CR-180986] N89-14479

**SEALS (STOPPERS)**
Leakage predictions for Rayleigh-step, helium-purge seals
[NASA-TM-101352] N89-14255
Some composite bearing and seal materials for gas turbine applications: A review
[NASA-TM-101451] N89-14338

**SEARCHING**
IN-ATE: Fault diagnosis as expert system guided search N89-14757

**SEAS**
The role of horizontal processes in upper-ocean prediction: A forecast simulation in the Sea of Japan
[AD-A198827] N89-14654

**SEASONS**
Measurements of ozone in the Antarctic region during August and September of 1987 N89-14552
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585

**SEDIMENTS**
Sediment-transport experiments in zero-gravity N89-15020
The initiation of grain movement by wind N89-15029

**SEISMOGRAPHS**
Qualitative aspects of seismograph/ocean bottom interaction
[AD-A198652] N89-14656

**SELF ADAPTIVE CONTROL SYSTEMS**
Self-adaptive databases
[AD-A197883] N89-14944

**SEMANTICS**
Computation via direct manipulation
[AD-A198417] N89-14690

**SEMICONDUCTING FILMS**
Investigation of a new concept in semiconductor microwave oscillators
[AD-A198039] N89-14380

**SEMICONDUCTOR DEVICES**
A fast ion beam pattern generator
[ETN-89-93354] N89-14350
Fundamental quantum 1/F noise in ultrasmall semiconductor devices and their optimal design principles
[AD-A198462] N89-14381
Offset reduction and three dimensional field sensing with magnetotransistors
[ETN-89-93349] N89-14890

**SEMICONDUCTOR DIODES**
Fundamental quantum 1/F noise in ultrasmall semiconductor devices and their optimal design principles
[AD-A198462] N89-14381
Semiconductor laser diodes and the design of a D.C. powered laser diode drive unit
[AD-A198556] N89-14441
Transport and junction physics of semiconductor-metal eutectic composites
[AD-A198480] N89-14884

**SEMICONDUCTOR JUNCTIONS**
Break junctions 1
[PB88-241849] N89-14869

**SEMICONDUCTOR LASERS**
Electron-beam-pumped semiconductor lasers N89-14425
Semiconductor laser diodes and the design of a D.C. powered laser diode drive unit
[AD-A198556] N89-14441

**SEMICONDUCTORS (MATERIALS)**
Investigation of a new concept in semiconductor microwave oscillators
[AD-A198039] N89-14380

Surface flashover threshold and switched fields of photoconductive semiconductor switches
| DE88-011618 | N89-14876
Semiconducting transition metal silicides: New materials for optoelectronics on silicon
| AD-A198139 | N89-14881

**SENSITIVITY**
Radiation sensitivity of soluble polysilane derivatives: Science and applications
| AD-A198805 | N89-14313
Design sensitivity analysis and optimization of nonlinear structures: A unified approach
| PB88-235171 | N89-14458
Analysis of crop loss for alternative ozone exposure indices
| PB88-214788 | N89-14608

**SENSORS**
Fiber-optic spectrochemical emission sensors
| DE88-017175 | N89-14275
Sensor-based diagnosis using knowledge of structure and function N89-14770

**SEQUENCING**
On exceedance point processes for stationary sequences under mild oscillation restrictions
| AD-A198314 | N89-14806

**SERVOMECHANISMS**
The effect of transmission design on force-controlled manipulator performance
| AD-A198131 | N89-14689

**SEYFERT GALAXIES**
Optical spectroscopy of X-ray: Selected active galactic nuclei N89-15049

**SHEAR FLOW**
Constitutive relations for rapidly sheared granular flows: A Monte Carlo form based on the kinetic theory of dense gases N89-14387

**SHEAR PROPERTIES**
Fracture behaviour under impact 2
| AD-A198643 | N89-14467

**SHEAR STRENGTH**
Bonding at metal-ceramic interfaces in hybrid materials
| AD-A197928 | N89-14261

**SHELLS (STRUCTURAL FORMS)**
Modifying PASVART to solve singular nonlinear 2-point boundary problems N89-14906

**SHOCK LOADS**
Shock response spectrum anomalies which occur due to imperfections in the data
| DE88-015846 | N89-14459

**SHOCK SPECTRA**
Shock response spectrum anomalies which occur due to imperfections in the data
| DE88-015846 | N89-14459

**SHOCK TESTS**
Shaker shock testing using nonstationary random transients
| DE88-015847 | N89-14460

**SHOCK WAVES**
Use of time-resolved techniques for studying shock-induced vaporization
| DE88-017168 | N89-14395
Shaker shock testing using nonstationary random transients
| DE88-015847 | N89-14460
A planetary ultra hypervelocity impact mechanics and shock wave science facility N89-15005

**SIDEBANDS**
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
| AD-A198361 | N89-14439

**SIGNAL DETECTION**
A new method for trace metal determinations by monitoring modulated magnetically induced optical rotation in atomic vapours
| AD-A198799 | N89-14272

**SIGNAL DETECTORS**
Detector evaluation for optical signals
| AD-A198133 | N89-14836

**SIGNAL PROCESSING**
NAVSPASUR system performance analysis
| AD-A198848 | N89-14252
Combining signals of widely differing bit rates on fiber optic subscriber lines
| PB88-210067 | N89-14352
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
| AD-A198656 | N89-14367
Optical fiber data transfer system
| NASA-CR-181704 | N89-14376
Frequency domain laser velocimeter signal processor
| NASA-CASE-LAR-13552-1-CU | N89-14385
Shock response spectrum anomalies which occur due to imperfections in the data
| DE88-015846 | N89-14459
Automatic detection of inversions using sodar
| KNMI-TR-106 | N89-14631
A survey of the state-of-the-art and focused research in range systems
| NASA-CR-184595 | N89-14726

**SIGNAL TO NOISE RATIOS**
Description of the RSG-10 noise data base --- speech recognition/communication
| IZF-1988-03 | N89-14945

**SILANES**
Block interrupt polysilane derivatives
| AD-A198804 | N89-14312
Radiation sensitivity of soluble polysilane derivatives: Science and applications
| AD-A198805 | N89-14313

**SILICATES**
Volatilization-fractionation of silicates related to chondrite composition N89-15036

**SILICIDES**
Semiconducting transition metal silicides: New materials for optoelectronics on silicon
| AD-A198139 | N89-14881

**SILICON**
Composite foams
| DE89-000368 | N89-14315
Measurement precautions for high-resistivity silicon solar cells
| DE89-000438 | N89-14499
Crystalline silicon photovoltaic cell technology: Meeting the challenge for utility power
| DE89-000439 | N89-14500
The effect of parasitic absorption losses on light trapping in thin silicon solar cells
| DE89-000457 | N89-14501
Inversion boundaries in GaAs grown on Si
| DE89-000568 | N89-14875
Photonic applications of thin film GaAs grown on silicon and insulating substrates by molecular beam epitaxy
| DE88-016975 | N89-14877
Long-lived resonance states in Si-doped AlGaAs
| DE89-000305 | N89-14879

**SILICON CARBIDES**
Creep behavior of an Al2O3-SiC composite
| DE88-014553 | N89-14260

**SILICON DIOXIDE**
Vibration spectra of silica near 2400 K: Measurement and molecular dynamics simulation
| DE88-015925 | N89-14314

**SILICON JUNCTIONS**
Transport and junction physics of semiconductor-metal eutectic composites
| AD-A198480 | N89-14884

**SILICON POLYMERS**
Polysilylated unsaturated molecules
| AD-A198492 | N89-14328

**SILICON TRANSISTORS**
Transport and junction physics of semiconductor-metal eutectic composites
| AD-A198480 | N89-14884

**SILVER**
Electrochemical studies of molten glass N89-14266
The surface enhanced raman scattering of the protonated forms of DABCO at a silver electrode
| AD-A197930 | N89-14278

**SIMPLEX METHOD**
Network management of highly adaptive communication networks
| AD-A198429 | N89-14362

**SIMULATION**
Investigation of a moving-model technique for measuring ground effect
| NASA-TM-4080 | N89-14217
Fire extinguishing agent evaluation in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS)
| AD-A198523 | N89-14227
A numerical simulation of the full two-dimensional electrothermal de-icer pad
| NASA-CR-4194 | N89-14235
Simulation of 3-D viscous flow within a multi-stage turbine
| NASA-TM-101376 | N89-14238
Influence of the A.C. Stark effect on stimulated hyper-Raman profiles in sodium vapor
| DE88-015557 | N89-14429
The electron laser facility: A millimeter wave free-electron laser amplifier
| DE88-016118 | N89-14436
Numerical simulation of injection molding: Non-isothermal non-Newtonian flow of polymers in complex geometries
| ETN-89-93348 | N89-14727
Parallel processing techniques for the simulation of MOS VLSI circuits using waveform relaxation
| AD-A197879 | N89-14734
Simulation studies for surfaces and materials strength
| NASA-CR-183378 | N89-14824
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899
An investigation of turbulence models N89-14905
The effects of atomic oxygen on polymeric materials N89-14921
Modelling of central density spectra of extensive air showers from primary particles with E = 10(sup 2)-10(sup 7) GeV
| DE88-703728 | N89-15069

**SIMULATORS**
Fire extinguishing agent evaluation in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS)
| AD-A198523 | N89-14227
Fabrication and testing of lightweight hydraulic system simulator hardware. Phase 2: Addendum
| AD-A198524 | N89-14243
General specifications for the development of a PC-based simulator of the NASA RECON system
| NASA-CR-184536 | N89-14976
The USL NASA PC R and D project: Detailed specifications of objects
| NASA-CR-184540 | N89-14980

**SINGLE CRYSTALS**
Critical fields and characteristic lengths in copper oxide superconductors
| DE89-000543 | N89-14872
Preparation, structure, and spectroscopic properties of nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 crystals
| AD-A198476 | N89-14883

**SINTERING**
Composite ceramic superconducting filaments for superconducting cable
| AD-A198657 | N89-14888

**SITE SELECTION**
Mining for helium: Site selection and evaluation N89-14850

**SKIN FRICTION**
A numerical simulation of the flow field and heat transfer in a rectangular passage with a turbulence promoter
| AD-A198579 | N89-14400
Modeling of transitional flows N89-14917

**SKY**
Daylight and twilight sky radiance and terrestrial irradiance
| AD-A198550 | N89-14628

**SKY BRIGHTNESS**
Daylight and twilight sky radiance and terrestrial irradiance
| AD-A198550 | N89-14628

**SLENDER WINGS**
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
| NASA-CR-181724 | N89-14896
Optimization of slender wings for center-of-pressure shift due to change in Mach number N89-14897

**SLIDING FRICTION**
The role of thermoelastic effects in the scuffing failure of rolling/sliding EHD contacts
| AD-A198475 | N89-14447

**SLOTS**
Transverse effects of a waveguide coupling slot
| DE89-000340 | N89-14356
Electromagnetic penetration through finite-length narrow slots in planar conducting screens
| DE88-016046 | N89-14370

**SMOKE**
Nucleation and particle coagulation experiments in microgravity N89-15030

**SNOW COVER**
Remote sensing technologies and spatial data applications
| AD-A195809 | N89-14480
Specular reflection coefficient of snow at 10, 35 and 94 GHz as a function of grazing angle (Oberjettenberg-Campaign)
| FEL-1988-01 | N89-14495

**SOCIOLOGY**
Social sciences and space exploration
| EP-192 | N89-14895

**SODAR**
Automatic detection of inversions using sodar
| KNMI-TR-106 | N89-14631

**SODIUM VAPOR**
Influence of the A.C. Stark effect on stimulated hyper-Raman profiles in sodium vapor
| DE88-015557 | N89-14429

**SOFTWARE ENGINEERING**
Composing data and process descriptions in the design of software systems
| AD-A198096 | N89-14714
A generic architecture for knowledge-based equipment fault diagnosis N89-14767
USL/DBMS NASA/PC R and D project system testing standards
| NASA-CR-184545 | N89-14985

**SOFTWARE TOOLS**
IMAT (Integrated Multidisciplinary Analysis Tool) user's guide for the VAX/VMS computer
| NASA-TM-101500 | N89-14475
GDS: An intelligent diagnostic software shell N89-14766
An evaluation of five PC-based expert system shells
| AD-A197915 | N89-14773
A report on the USL NASA/RECON project. Part 2: PC-based R and D in support of IS and R applications
| NASA-CR-184516 | N89-14956
**SOIL MOISTURE**
Remote sensing technologies and spatial data applications
| AD-A195809 | N89-14480
Determination of soil moisture beneath a stalk or trunk dominated canopy
| NASA-CR-183322 | N89-14621
**SOLAR CELLS**
Design of fault-tolerant circuits for photovoltaic concentrators
| DE89-001062 | N89-14379
US photovoltaic patents, 1951--1987
| DE88-001178 | N89-14497
Photovoltaics as an operating energy system
| DE88-017167 | N89-14498
Measurement precautions for high-resistivity silicon solar cells
| DE89-000438 | N89-14499
Crystalline silicon photovoltaic cell technology: Meeting the challenge for utility power
| DE89-000439 | N89-14500
The effect of parasitic absorption losses on light trapping in thin silicon solar cells
| DE89-000457 | N89-14501
Rugged, thin GaAs solar cell development
| AD-A198533 | N89-14502
**SOLAR DYNAMIC POWER SYSTEMS**
Power systems facility
| NASA-TM-101447 | N89-14247
**SOLAR ENERGY**
Daylight and twilight sky radiance and terrestrial irradiance
| AD-A198550 | N89-14628
**SOLAR NEUTRINOS**
The Baksan Neutrino Observatory Soviet-American Gallium Solar Neutrino Experiment
| DE89-000375 | N89-15061
**SOLAR NEUTRONS**
Predicted performance of a prototype solar neutron detector N89-15064
**SOLAR OSCILLATIONS**
An investigation of ground-based observations of solar oscillations at Stanford N89-15060
**SOLAR RADIATION**
Daylight and twilight sky radiance and terrestrial irradiance
| AD-A198550 | N89-14628
**SOLAR SPECTRA**
Infrared measurements in the spring 1987 ozone hole N89-14547
**SOLAR SYSTEM**
Experimental cosmochemistry in the Space Station N89-15002
Experimental constraints on the origin of chondrules N89-15043
**SOLAR WIND**
Analysis of ISEE-3/ICE solar wind data
| NASA-CR-184652 | N89-15063
**SOLDERED JOINTS**
Infrared temperature monitoring and control of final solder-joint temperature on flat flex cables
| DE89-000409 | N89-14349
Modified soldered joints of current-carrying superconductors
| DE88-703754 | N89-14878
**SOLID PHASES**
Ternary solid phase equilibria in the systems (Ag,In,Au)-(Cd,He)-Te
| AD-A198679 | N89-14302
Chemical variability in ocean frontal areas
| AD-A198418 | N89-14655
Solid phase equilibria in the Pt-Ga-As and Pt-Ga-Sb systems
| AD-A198654 | N89-14887
**SOLID PROPELLANTS**
The synthesis of carborane-oxetane monomers and their polymerization
| AD-A198596 | N89-14330
**SOLID ROCKET BINDERS**
A preliminary report on developing an expert system for computer-aided formulation of propellants
| AD-A198088 | N89-14339
**SOLID STATE**
Variable temperature solid state NMR of side-chain crystalline comb polymers
| AD-A198099 | N89-14322
Solid state research
| NASA-CR-183328 | N89-14342
**SOLID STATE DEVICES**
Monolithic two-dimensional surface-emitting arrays of GaAs/AlGaAs diode lasers N89-14343
**SOLID-SOLID INTERFACES**
Bonding at metal-ceramic interfaces in hybrid materials
| AD-A197928 | N89-14261
**SOLIDIFICATION**
Effects of crucible wetting during solidification of immiscible Pb-Zn
| NASA-TM-101372 | N89-14341
**SOLIDS**
Quantitative holographic interferometry: Measurement of solid object deformations
| ETN-89-93351 | N89-14420
**SOLUTIONS**
Rheological and rheo-optical studies with nematogenic solutions of a rodlike polymer: A review of data on poly(phenylene benzobisthiazole)
| AD-A197994 | N89-14318
**SONIC BOOMS**
Detailed design specification for a prototype Assessment System for Aircraft Noise (ASAN)
| AD-A197936 | N89-14818
**SOUND PRESSURE**
Users' manual for the Langley high speed propeller noise prediction program (DFP-ATP)
| NASA-CR-4208 | N89-14820
**SOUND TRANSMISSION**
Sound attenuation and speech transmission quality of five types of headsets
| IZF-1987-23 | N89-14373
**SOUTHERN HEMISPHERE**
The breakup of the Southern Hemisphere spring polar ozone and temperature minimums from 1979 to 1987 N89-14506
The morphology and meteorology of Southern Hemisphere spring total ozone mini-holes N89-14516
Southern Hemispheric nitrous oxide measurements obtained during 1987 airborne Antarctic ozone experiment N89-14557
Comparison of the poleward transport of ozone in the Northern and Southern Hemispheres N89-14591
**SPACE BASED RADAR**
Nuclear reactor power as applied to a space-based radar mission
| NASA-TM-101200 | N89-14831
**SPACE CHARGE**
The electron laser facility: A millimeter wave free-electron laser amplifier
| DE88-016118 | N89-14436
**SPACE COMMERCIALIZATION**
Commercial objectives, technology transfer, and systems analysis for fusion power development N89-14851
Synergism of He-3 acquisition with lunar base evolution N89-14852
A system for conducting igneous petrology experiments under controlled redox conditions in reduced gravity N89-15040
**SPACE FLIGHT**
Rugged, thin GaAs solar cell development
| AD-A198533 | N89-14502
**SPACE FLIGHT FEEDING**
Space shuttle food system summary, 1981-1986
| NASA-TM-100469 | N89-14693
**SPACE OBSERVATIONS (FROM EARTH)**
An investigation of ground-based observations of solar oscillations at Stanford N89-15060
**SPACE PLATFORMS**
Control of the flexible modes of an advanced technology geostationary platform N89-14902
**SPACE POWER REACTORS**
Nuclear reactor power as applied to a space-based radar mission
| NASA-TM-101200 | N89-14831
**SPACE PROCESSING**
Effects of crucible wetting during solidification of immiscible Pb-Zn
| NASA-TM-101372 | N89-14341
Multicolor pyrometer for materials processing in space, phase 2
| NASA-CR-183358 | N89-14406
Crystal growth of CdTe in space and thermal field effects on mass flux and morphology
| NASA-CR-183263 | N89-14868
**SPACE RATIONS**
Space shuttle food system summary, 1981-1986
| NASA-TM-100469 | N89-14693
**SPACE SHUTTLE MAIN ENGINE**
Heat flux measurements
| NASA-TM-101428 | N89-14418
Dynamic analysis of nonlinear rotor-housing systems
| NASA-CR-184611 | N89-14449
**SPACE SHUTTLE MISSION 31-C**
Studies of the horizontal vestibulo-ocular reflex on STS 7 and 8
| NASA-TM-100468 | N89-14677
**SPACE SHUTTLE MISSION 31-D**
Studies of the horizontal vestibulo-ocular reflex on STS 7 and 8
| NASA-TM-100468 | N89-14677
**SPACE SHUTTLE MISSION 41-G**
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
| NASA-TM-100459-VOL-1 | N89-14331
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
| NASA-TM-100459-VOL-2 | N89-14332
**SPACE SHUTTLE PAYLOADS**
Space station commonality analysis
| NASA-CR-179422 | N89-14251
Space shuttle large format camera photography cloud cover interference diagrams
| PB88-244405 | N89-14482
Cosmic dust collection with a sub satellite tethered to a Space Station N89-15010
Ultraviolet spectroscopy of meteoric debris: In situ calibration experiments from earth orbit N89-15031
**SPACE SHUTTLES**
Iodine sorption study on the proposed use of Viton A in a shuttle galley water accumulator
| NASA-TM-100467 | N89-14691
Space shuttle food system summary, 1981-1986
| NASA-TM-100469 | N89-14693
Social sciences and space exploration
| EP-192 | N89-14895
**SPACE STATION PAYLOADS**
Experiments in Planetary and Related Sciences and the Space Station
| NASA-CP-2494 | N89-14998
Planetary impact experimentation N89-14999
Physics of windblown particles N89-15000
Particle formation and interaction N89-15001
Experimental cosmochemistry in the Space Station N89-15002
Report on OTHER proposals for SSPEX N89-15003
Proposed earth-based cratering experiments at low g in hard vacuum N89-15006
Cosmic dust collection with a sub satellite tethered to a Space Station N89-15010
The orbit properties of colliding co-orbiting bodies N89-15013
Volatilization-devolatilization reactions N89-15014
Small linear wind tunnel saltation experiments: Some experiences N89-15015
Impact experimentation and the microgravity environment: An overview N89-15016
Exobiology experiment concepts for Space Station N89-15017
Experimental studies of crystal-melt differentiation in planetary basalt compositions N89-15018
Kinetics of mineral condensation in the solar nebula N89-15019
Sediment-transport experiments in zero-gravity N89-15020
Design and calibration of the carousel wind tunnel N89-15021
A magnetospheric simulation at the Space Station N89-15024
Kinetics in a turbulent nebular cloud N89-15025
Cautionary tales for reduced-gravity particle research N89-15026
Electrostatic aggregation of finely-comminuted geological materials N89-15027
Crystal-liquid-vapor equilibrium experiments at high temperature (less than or equal to 1800 C) and low, controlled oxygen and hydrogen pressure (10(-1) to 10(-9) PA) N89-15028
Nucleation and particle coagulation experiments in microgravity N89-15030
Low-gravity facilities for Space Station planetology experiments N89-15032
Debris-cloud collisions: Accretion studies in the Space Station N89-15033
Impacts of free-floating objects: Unique Space Station experiments N89-15034
Grain dynamics in zero gravity N89-15038
Aeolian processes aboard a Space Station: Saltation and particle trajectory analysis N89-15039
A system for conducting igneous petrology experiments under controlled redox conditions in reduced gravity N89-15040
New techniques for the detection and capture of micrometeoroids N89-15041

Experimental constraints on heating and cooling rates of refractory inclusions in the early solar system N89-15042
Experimental constraints on the origin of chondrules N89-15043
Experimental correlation of melt structures, nucleation rates, and thermal histories of silicate melts N89-15044
Containerless high-pressure petrology experiments in the microgravity environment of the Space Station N89-15045
Mapping experiment with space station N89-15046

**SPACE STATIONS**
Power systems facility
| NASA-TM-101447 | N89-14247
Space station commonality analysis
| NASA-CR-179422 | N89-14251
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
| NASA-CR-181724 | N89-14896
Some test/analysis issues for the space station structural characterization experiment N89-14901
An overview of the program to place advanced automation and robotics on the Space Station N89-15004
A planetary ultra hypervelocity impact mechanics and shock wave science facility N89-15005

**SPACEBORNE EXPERIMENTS**
Some test/analysis issues for the space station structural characterization experiment N89-14901
Experiments in Planetary and Related Sciences and the Space Station
| NASA-CP-2494 | N89-14998
A planetary ultra hypervelocity impact mechanics and shock wave science facility N89-15005
Proposed earth-based cratering experiments at low g in hard vacuum N89-15006
Cosmic dust collection with a sub satellite tethered to a Space Station N89-15010
Impact experimentation and the microgravity environment: An overview N89-15016
Exobiology experiment concepts for Space Station N89-15017
Experimental studies of crystal-melt differentiation in planetary basalt compositions N89-15018
Kinetics of mineral condensation in the solar nebula N89-15019
Sediment-transport experiments in zero-gravity N89-15020
Design and calibration of the carousel wind tunnel N89-15021
A magnetospheric simulation at the Space Station N89-15024
Kinetics in a turbulent nebular cloud N89-15025
Electrostatic aggregation of finely-comminuted geological materials N89-15027
Ultraviolet spectroscopy of meteoric debris: In situ calibration experiments from earth orbit N89-15031
Debris-cloud collisions: Accretion studies in the Space Station N89-15033
Impacts of free-floating objects: Unique Space Station experiments N89-15034
Grain dynamics in zero gravity N89-15038
Aeolian processes aboard a Space Station: Saltation and particle trajectory analysis N89-15039
A system for conducting igneous petrology experiments under controlled redox conditions in reduced gravity N89-15040
Experimental constraints on heating and cooling rates of refractory inclusions in the early solar system N89-15042

**SPACEBORNE PHOTOGRAPHY**
Space shuttle large format camera photography cloud cover interference diagrams
| PB88-244405 | N89-14482

**SPACECRAFT COMMUNICATION**
Spacelab system analysis: A study of communications systems for advanced launch systems
| NASA-CR-183515 | N89-14248
Spacelab system analysis: A study of the Marshall Avionics System Testbed (MAST)
| NASA-CR-183516 | N89-14354

**SPACECRAFT CONSTRUCTION MATERIALS**
Stability of bulk Ba2YCu3O(7-x) in a variety of environments
| NASA-TM-101401 | N89-14310
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
| NASA-TM-100459-VOL-1 | N89-14331
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
| NASA-TM-100459-VOL-2 | N89-14332

**SPACECRAFT CONTROL**
Aeroassisted orbital transfer vehicle control technology
| NASA-CR-179424 | N89-14250
Control of the flexible modes of an advanced technology geostationary platform N89-14902

**SPACECRAFT DESIGN**
Transfer airlock requirements
| TAL-RP-SN-003 | N89-14254

**SPACECRAFT ENVIRONMENTS**
Effects of electron irradiation on high temperature superconductors and contacts to high temperature superconductors N89-14900
Benchmark solutions for the galactic ion transport equations with spatial and energy coupling N89-14907

**SPACECRAFT EQUIPMENT**
Capillary heat transport and fluid management device
| NASA-CASE-MFS-28217-1 | N89-14392

**SPACECRAFT GLOW**
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
| NASA-TM-100459-VOL-1 | N89-14331
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
| NASA-TM-100459-VOL-2 | N89-14332

**SPACECRAFT POWER SUPPLIES**
Power systems facility
| NASA-TM-101447 | N89-14247

**SPACECRAFT RADIATORS**
Liquid sheet radiator apparatus
| NASA-CASE-LEW-14295-1 | N89-14348

**SPACECRAFT TEMPERATURE**
Capillary heat transport and fluid management device
| NASA-CASE-MFS-28217-1 | N89-14392

**SPACECRAFT TRAJECTORIES**
Simulation and analysis of a Geopotential Research Mission N89-14478

**SPACELAB**
Spacelab system analysis: A study of communications systems for advanced launch systems
| NASA-CR-183515 | N89-14248
Spacelab system analysis: A study of the Marshall Avionics System Testbed (MAST)
| NASA-CR-183516 | N89-14354

**SPACING**
Spacing effects in learning described by the SAM model. Comparing three versions of the SAM model
| PB88-204060 | N89-14678

**SPATIAL DISTRIBUTION**
Near UV atmospheric absorption measurements from the DC-8 aircraft during the 1987 airborne Antarctic ozone experiment N89-14544
Temporal and spatial distribution of stratospheric trace gases over Antarctica in August and September, 1987 N89-14551
In situ observations of ClO in the Antarctic: Evidence for chlorine catalyzed destruction of ozone N89-14554
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585

**SPATIAL RESOLUTION**
Effect of heat release on the spatial stability of a supersonic reacting mixing layer
| NASA-CR-181753 | N89-14402

**SPECIFICATIONS**
ETX-I: First-generation single-shaft electric propulsion system program. Volume 2: Battery
| DE89-000079 | N89-14378
RADC (Rome Air Development Center) system/software requirements engineering testbed research and development program
| AD-A197858 | N89-14711
The USL NASA PC R and D project: General specifications of objectives
| NASA-CR-184534 | N89-14974
General specifications for the development of a PC-based simulator of the NASA RECON system
| NASA-CR-184536 | N89-14976
General specifications for the development of a USL NASA PC R and D statistical analysis support package
| NASA-CR-184537 | N89-14977
General specifications for the development of a USL/DBMS NASA/PC R and D distributed workstation
| NASA-CR-184538 | N89-14978
The USL NASA PC R and D project: Detailed specifications of objects
| NASA-CR-184540 | N89-14980
USL/DBMS NASA/PC R and D project system design standards
| NASA-CR-184544 | N89-14984
NASA PC software evaluation project
| NASA-CR-184550 | N89-14990

**SPECKLE PATTERNS**
Method and apparatus for reducing speckle
| NASA-CASE-LAR-13771-1 | N89-14428

**SPECTRAL BANDS**
A new method for trace metal determinations by monitoring modulated magnetically induced optical rotation in atomic vapours
| AD-A198799 | N89-14272

**SPECTRAL EMISSION**
Fiber-optic spectrochemical emission sensors
| DE88-017175 | N89-14275

**SPECTRAL METHODS**
Single-grid spectral collocation for the Navier-Stokes equations
| NASA-CR-181754 | N89-14799
An example of a harmonizable process whose spectral domain is not complete
| NASA-CR-184653 | N89-14800

**SPECTRAL THEORY**
A split-Levinson approach to autoregressive modeling
| AD-A198535 | N89-14722

**SPECTROMETERS**
A new method for trace metal determinations by monitoring modulated magnetically induced optical rotation in atomic vapours
| AD-A198799 | N89-14272
The future of intelligent spectrometers in metal speciation by atomic emission spectrometry
| AD-A198592 | N89-14287
Estimation of errors in the TOMS total ozone measurement during the Antarctica ozone campaign of August/September 1987 N89-14510
Seasonal and temporal changes in the vertical profiles of polar stratospheric ozone: 1978-1986 N89-14513
Ozone profile measurements at McMurdo Station Antarctica during the spring of 1987 N89-14514
Variations of total ozone in the north polar region as seen by TOMS N89-14571
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic N89-14577

**SPECTROPHOTOMETERS**
Total ozone by lunar Dobson observation at Syowa, Antarctica N89-14504
Brewer spectrophotometer measurements in the Canadian Arctic N89-14579

**SPECTROSCOPIC ANALYSIS**
Application of inductively coupled plasma atomic emission spectroscopy analysis with a polychromator/monochromator combination the byproducts of coal-fired power stations
| PB88-226535 | N89-14838

**SPECTROSCOPY**
Detection of ions by replacement-ion chromatography coupled to a microwave-induced nitrogen discharge at atmospheric pressure
| AD-A198800 | N89-14273
Visible and near-ultraviolet spectroscopy at Thule AFB (76.5 N) from January 28 - February 15, 1988 N89-14576
Molecular beam studies of surface phonons and gas surface interactions
| AD-A198435 | N89-14826
A spectroscopic characterization of the structure of supported metal catalysts
| B8811777 | N89-14889
Spectroscopic investigation of the Cr to Tm energy transfer in Yttrium Aluminum Garnet (YAG) crystals N89-14903
Report on OTHER proposals for SSPEX N89-15003

**SPECTRUM ANALYSIS**
Statistical model of environmental contaminants using variance spectrum analysis
| PB88-235130 | N89-14615
Pair production and annihilation in gamma-ray bursts N89-15065

**SPECULAR REFLECTION**
Specular reflection coefficient of snow at 10, 35 and 94 GHz as a function of grazing angle (Oberjettenberg-Campaign)
| FEL-1988-01 | N89-14495

**SPEECH RECOGNITION**
Automatic speaker recognition system
| AD-A197980 | N89-14358
Sound attenuation and speech transmission quality of five types of headsets
| IZF-1987-23 | N89-14373
Description of the RSG-10 noise data base --- speech recognition/communication
| IZF-1988-03 | N89-14945

**SPHERICAL HARMONICS**
An investigation of ground-based observations of solar oscillations at Stanford N89-15060

**SPIN-LATTICE RELAXATION**
Nuclear spin cooling using antiferromagnetic magnons N89-14822
Methods of analysis of coupled spin-lattice relaxations and spin diffusion in heterogeneous organic solids with application to keratin N89-14823

**SPIRAL GALAXIES**
A study of environmental influences on the structure of spiral galaxy disks N89-15051
The nature of luminous IRAS galaxies N89-15053

**SPLINE FUNCTIONS**
B-spline-Bezier representation of tau-splines
| AD-A197937 | N89-14791
**SPRAYED COATINGS**
Multilayer plasma coats used as thermal barrier in engines
| ETN-89-93598 | N89-14333
**SPRAYERS**
Analysis of transport mechanisms in dense fuel droplet sprays
| DE88-017256 | N89-14393
**SPRING (SEASON)**
Antarctic measurements of ozone, water vapor, and aerosol extinction by Sage 2 in the spring of 1987 N89-14508
Quantitative observations of the behavior of anomalous low altitude ClO in the Antarctic spring Stratosphere, 1987 N89-14548
Dehydration in the lower Antarctic stratosphere in late winter and spring N89-14564
Transport into the south polar vortex in early spring N89-14567
Decending motion of particle and its effect on ozone hole chemistry N89-14570
Springtime surface ozone fluctuations at high Arctic latitudes and their possible relationship to atmospheric bromine N89-14581
Diagnostic studies of the 1987 Antarctic spring vortex N89-14587
Evolution of the Antarctic polar vortex in spring: Response of a GCM to a prescribed Antarctic ozone hole N89-14589
**SQUEEZE FILMS**
Identification of dynamic parameters of a squeeze-film bearing N89-14443
**STABILITY**
Design of feedback control systems for unstable plants with saturating actuators
| NASA-CR-183392 | N89-14377
Effect of heat release on the spatial stability of a supersonic reacting mixing layer
| NASA-CR-181753 | N89-14402
**STABILIZATION**
Numerical schemes in the stabilization method for nonlinear differential equations of second order
| DE88-703773 | N89-14789
**STANDARDIZATION**
Aircraft emissions characterization
| AD-A197864 | N89-14617
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems
| NASA-CR-184523 | N89-14963
Design criteria for a PC-based common user interface to remote information systems
| NASA-CR-184541 | N89-14981
**STANDARDS**
Human factors in the Naval Air Systems Command: Computer based training
| DE88-015301 | N89-14686
CD-ROM (Compact Disc Read Only Memory) library of the future
| AD-A197943 | N89-14702
A national intercomparison of hydrophone calibration methods
| NPL-AC-116 | N89-14819
An intercomparison of the radium mass standards of the UK and the USSR
| NPL-RS(EXT)-103 | N89-14828
USL/DBMS NASA/RECON working paper series. Standards
| NASA-CR-184508 | N89-14948
The USL NASA PC R and D development environment standards
| NASA-CR-184535 | N89-14975
USL/DBMS NASA/PC R and D project C programming standards
| NASA-CR-184543 | N89-14983
USL/DBMS NASA/PC R and D project system design standards
| NASA-CR-184544 | N89-14984
USL/DBMS NASA/PC R and D project system testing standards
| NASA-CR-184545 | N89-14985
**STAR FORMATION**
The nature of luminous IRAS galaxies N89-15053
CCD polarimetry as a probe of regions of recent star-formation N89-15054
CO and IRAS FIR emission in interacting galaxies N89-15058
**STARK EFFECT**
Influence of the A.C. Stark effect on stimulated hyper-Raman profiles in sodium vapor
| DE88-015557 | N89-14429
**STATISTICAL ANALYSIS**
Mathematical sciences: Some research trends
| PB88-232798 | N89-14779
Numerical methods for turbulent flow N89-14928
General specifications for the development of a USL NASA PC R and D statistical analysis support package
| NASA-CR-184537 | N89-14977
Linear clusters of galaxies N89-15050
**STATISTICAL DISTRIBUTIONS**
The language distribution of bibliographic records in selected online databases N89-14940
**STATISTICAL MECHANICS**
Application developer's tutorial for the CSM testbed architecture
| NASA-CR-181732 | N89-14473
Dynamics of observed reality: Abridged version of classical and quantum mechanics
| AD-A198637 | N89-14894
**STATISTICAL TESTS**
On the connection of geodetic point fields in Reseau European Trigonometrique (RETRIG) and related tests for model errors
| ETN-89-93327 | N89-14485
A note on extended quasi-likelihood
| AD-A198042 | N89-14805
**STEADY FLOW**
A finite difference analysis of the heat transfer in periodic cavity flows N89-14389
**STEELS**
Two-bar thermal ratchetting of annealed 2.25Cr-1Mo steel N89-14304
Durability of adhesive joints: An engineering study
| PB88-233473 | N89-14307
**STELLAR ENVELOPES**
The circumstellar envelopes of young stellar objects and emission line stars N89-15066
**STELLAR EVOLUTION**
Stellar masses and laboratory astrophysics N89-15056
**STELLAR LUMINOSITY**
Optical spectroscopy of X-ray: Selected active galactic nuclei N89-15049
**STELLAR MASS**
Stellar masses and laboratory astrophysics N89-15056
**STELLAR MASS ACCRETION**
Disk accretion onto weakly magnetized neutron stars N89-15057
**STELLAR TEMPERATURE**
Stellar masses and laboratory astrophysics N89-15056
**STELLARATORS**
Panel on high beta and/or high field tokamaks and stellarators
| DE88-017367 | N89-14859
**STEREOPHOTOGRAPHY**
The use of short range stereophotogrammetry for facial asymmetry and growth studies; analysis and model
| B8821611 | N89-14491
**STEROIDS**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
| AD-A197472 | N89-14668
**STOCHASTIC PROCESSES**
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
| AD-A198361 | N89-14439
Robust algorithms for detecting a change in a stochastic process with infinite memory
| AD-A198290 | N89-14716
Sunset over Brownistan
| AD-A198443 | N89-14814
**STRAIN DISTRIBUTION**
A unified model for predicting the stress and strain distributions around cracks of any length, including elastic, plastic, creep and cyclic deformation N89-14455
**STRAIN GAGES**
Development of strain gage evaluation channels
| DE88-017350 | N89-14412
**STRAIN MEASUREMENT**
Efficient load measurements using singular value decomposition
| NASA-CR-184614 | N89-14795
**STRAITS**
Aerosol characteristics in the Marine Boundary Layer over the Straits of Gibraltar, June 1986
| AD-A197945 | N89-14642
**STRAPDOWN INERTIAL GUIDANCE**
Aspects of inertial investigation using a strapdown system
| ETN-89-93335 | N89-14229
**STRATOSPHERE**
Polar Ozone Workshop. Abstracts
| NASA-CP-10014 | N89-14503
Observations of stratospheric temperature changes coincident with the recent Antarctic ozone depletions N89-14507
NMC stratospheric analyses during the 1987 Antarctic expedition N89-14511
Seasonal and temporal changes in the vertical profiles of polar stratospheric ozone: 1978-1986 N89-14513
Ozone profiles above Palmer Station, Antarctica N89-14518
Total ozone, ozone vertical distributions, and stratospheric temperatures at South Pole, Antarctica, in 1986 and 1987 N89-14519
Correlation of N2O and ozone in the Southern Polar vortex during the airborne Antarctic ozone experiment N89-14520
Persistence of Antarctic polar stratospheric clouds N89-14521
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
Balloon borne Antarctic frost point measurements and their impact on polar stratospheric cloud theories N89-14524
Large-scale variations in ozone and polar stratospheric clouds measured with airborne lidar during formation of the 1987 ozone hole over Antarctica N89-14525
Antarctic polar stratospheric aerosols: The roles of nitrates, chlorides and sulfates N89-14527
On the size and composition of particles in polar stratospheric clouds N89-14528
Formation of polar stratospheric clouds simulated in a two dimensional model of the atmosphere N89-14529
Ice in the Antarctic polar stratosphere N89-14530
In-situ measurements of total reactive nitrogen, total water vapor, and aerosols in polar stratospheric clouds in the Antarctic stratosphere N89-14531
Extinction and backscatter measurements of Antarctic PSC's, 1987: Implications for particle and vapor removal N89-14532
Laboratory studies of HNO3/H2O mixtures at low temperatures N89-14533
Evolution of polar stratospheric clouds during the Antarctic winter N89-14534
Heterogeneous physicochemistry of the winter polar stratosphere N89-14535
Physical processes in polar stratospheric ice clouds N89-14536
Heterogeneous chemistry related to Antarctic ozone depletion: Reaction of ClONO2 and N2O5 on ice surfaces N89-14537
Mass accommodation coefficient measurements for HNO3, HCl and N2O5 on water, ice and aqueous sulfuric acid droplet surfaces N89-14538
Laboratory studies of sticking coefficients and heterogeneous reactions important in the stratosphere N89-14539
Lidar observations of polar stratospheric clouds at McMurdo, Antarctica, during NOZE-2 N89-14540
Observations of condensation nuclei in the 1987 airborne Antarctic ozone experiment N89-14541
Stratospheric column NO2 measurements from three Antarctic sites N89-14542
Ground-based measurements of O3, NO2, OClO, and BrO during the 1987 Antarctic ozone depletion event N89-14543
Infrared measurements of column amounts of stratospheric constituents in the Antarctic winter, 1987 N89-14545
Infrared aircraft measurements of stratospheric composition over Antarctica during September 1987 N89-14546
Infrared measurements in the spring 1987 ozone hole N89-14547
Quantitative observations of the behavior of anomalous low altitude ClO in the Antarctic spring Stratosphere, 1987 N89-14548
Daytime ClO over McMurdo in September 1987: Altitude profile retrieval accuracy N89-14549
An FTIR spectrometer for remote measurements of atmospheric composition N89-14550
Temporal and spatial distribution of stratospheric trace gases over Antarctica in August and September, 1987 N89-14551
Measurements of NO and total reactive odd-nitrogen, NOy, in the Antarctic stratosphere N89-14555
Dehydration in the lower Antarctic stratosphere in late winter and spring N89-14564
Photochemical modeling of the Antarctic stratosphere: Observational constraints from the airborne Antarctic ozone experiment and implications for ozone behavior N89-14569
Observations of stratospheric source gas profiles during the Arctic winter N89-14573
In situ observations of BrO over Antarctica: ER-2 aircraft results from 54 S to 72 S latitude N89-14583

The QBO and interannual variation in total ozone N89-14584
Polar vortex dynamics N89-14588
Radiative aspects of Antarctic ozone hole in 1985 N89-14592
High-resolution dynamical modelling of the Antarctic stratospheric vortex N89-14594
Simulation of the transport of halogen species from the equatorial and mid-latitude stratosphere to the polar stratosphere in a two-dimensional model N89-14595
A two-dimensional model of the quasi biennial oscillation of ozone N89-14596
Use of operational analyses to study the dynamics of troposphere-stratosphere interactions in polar regions N89-14597
Chemistry of chlorinated species in the Antarctic stratosphere N89-14598
Studies of ClO and BrO reactions important in the polar stratosphere: Kinetics and mechanism of the ClO + BrO and ClO + ClO reactions N89-14599
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product N89-14601
Chemistry of the CO dimer at low temperatures N89-14602
Modelling the Antarctic lower stratosphere N89-14603
The chemistry of Antarctic ozone 1960-1987 N89-14604
Modelling the Antarctic ozone hole N89-14605
Stratospheric feedback from continued increases in tropospheric methane N89-14606
High resolution FTIR spectroscopy of the ClO radical N89-14607
Assessing the risks of trace gases that can modify the stratosphere. Volume 1: Executive summary
| PB88-231055 | N89-14610
Assessing the risks of trace gases that can modify the stratosphere. Volume 6: Technical support documentation production projections
| PB88-231071 | N89-14611
Assessing the risks of trace gases that can modify the stratosphere. Volume 7: Technical support documentation atmospheric science papers
| PB88-231089 | N89-14612
Assessing the risks of trace gases that can modify the stratosphere. Volume 8: Technical support documentation ozone depletion and plants
| PB88-231097 | N89-14613
Long term studies of the refractive index structure parameter in the troposphere and stratosphere
| AD-A198313 | N89-14626

**STRATUS CLOUDS**
Scientific evaluation and assessment of ASL developed moist atmosphere models for low stratus subclouds
| AD-A198762 | N89-14625
Turbulence structure of Arctic stratus clouds derived from measurements and simulations
| DFVLR-FB-88-29 | N89-14633

**STRESS (PSYCHOLOGY)**
Working in impermeable clothing: Criteria for maximum stress
| IZF-1987-24 | N89-14692

**STRESS ANALYSIS**
Development of an endoscopic probe for radial metrology
| NASA-CR-184577 | N89-14417

**STRESS CONCENTRATION**
Temperature effect on stress concentration around circular hole in a composite material specimen representative of X-29A forward-swept wing aircraft
| NASA-CR-179439 | N89-14456
Fracture behaviour under impact 2
| AD-A198643 | N89-14467

**STRESS DISTRIBUTION**
A unified model for predicting the stress and strain distributions around cracks of any length, including elastic, plastic, creep and cyclic deformation N89-14455

**STRING THEORY**
Research Program in Elementary Particle Theory
| DE88-017241 | N89-14891

**STRONGLY COUPLED PLASMAS**
The future of intelligent spectrometers in metal speciation by atomic emission spectrometry
| AD-A198592 | N89-14287
The effect of torch pressure on analyte response in a 27 MHz inductively coupled plasma
| AD-A198595 | N89-14863

**STRUCTURAL ANALYSIS**
Condensation polymers with controlled structure
| AD-A198086 | N89-14321
Study of high temperature failure mechanisms in ceramics
| AD-A198375 | N89-14324
Development of strain gage evaluation channels
| DE88-017350 | N89-14412
System for the optimum design of structures
| ETN-89-93599 | N89-14451
Dynamics of structures: Solution techniques
| DE88-017022 | N89-14461
Dynamics of structures: Fundamentals
| DE88-017027 | N89-14462
Parametric studies of advanced turboprops
| NASA-TM-101389 | N89-14465
The computational structural mechanics testbed architecture. Volume 1: The language
| NASA-CR-178384 | N89-14472
Application developer's tutorial for the CSM testbed architecture
| NASA-CR-181732 | N89-14473
The CSM testbed matrix processors internal logic and dataflow descriptions
| NASA-CR-181742 | N89-14474
Extension and validation of a method for locating damaged members in large space trusses N89-14925

**STRUCTURAL DESIGN**
Multicolor pyrometer for materials processing in space, phase 2
| NASA-CR-183358 | N89-14406
Development and testing of a unique carousel wind tunnel to experimentally determine the effect of gravity and the interparticle force on the physics of wind-blown particles
| WHITE, BRUCE R. | N89-15022
Multi-object astronomical spectroscopy with optical fibres N89-15048

**STRUCTURAL INFLUENCE COEFFICIENTS**
Efficient load measurements using singular value decomposition
| NASA-CR-184614 | N89-14795

**STRUCTURAL VIBRATION**
Shaker shock testing using nonstationary random transients
| DE88-015847 | N89-14460
Equivalent linearization for fatigue life estimates of a nonlinear structure N89-14919

**STRUCTURES**
Design sensitivity analysis and optimization of nonlinear structures: A unified approach
| PB88-235171 | N89-14458
Sensor-based diagnosis using knowledge of structure and function N89-14770
A study of environmental influences on the structure of spiral galaxy disks N89-15051

**STUDENTS**
Living in space
| EP-222 | N89-14684

**SUBMERGING**
An advanced study of natural convection immersion cooling of a 3 x 3 array of simulated components in an enclosure filled with dielectric liquid
| AD-A197962 | N89-14398

**SUBSONIC FLOW**
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet
| AD-A198360 | N89-14399

**SUBSONIC SPEED**
Advanced core technology: Key to subsonic propulsion benefits
| NASA-TM-101420 | N89-14237

**SUBSONIC WIND TUNNELS**
The 13-inch magnetic suspension and balance system wind tunnel
| NASA-TM-4090 | N89-14241

**SUBSTRATES**
RF surface resistance of YBa2Cu3O(7-x) thin films N89-14347
Inversion boundaries in GaAs grown on Si
| DE89-000568 | N89-14875
Photonic applications of thin film GaAs grown on silicon and insulating substrates by molecular beam epitaxy
| DE88-016975 | N89-14877

**SULFATES**
Filter measurements of chemical composition during the airborne Antarctic ozone experiment N89-14526
Antarctic polar stratospheric aerosols: The roles of nitrates, chlorides and sulfates N89-14527

**SULFONES**
Radiation effects on polymeric materials N89-14914
The effects of atomic oxygen on polymeric materials N89-14921

**SULFUR**
Advanced concepts for contaminant resistant fuel cells
| DE88-017151 | N89-14496

**SUPERCOMPUTERS**
The birth of the second generation: The Hitachi S-820/80
| DE88-014439 | N89-14697
Design and implementation of a supercomputer frame buffer system
| DE88-007834 | N89-14703
Development of the general interpolants method for the CYBER 200 series of supercomputers
| NASA-CR-4183 | N89-14704
Evaluation of work distribution algorithms and hardware topologies in a multi-transputer network
| AD-A198530 | N89-14736

**SUPERCONDUCTORS**
Critical fields and characteristic lengths in copper oxide superconductors
| DE89-000543 | N89-14872
Bi-Ca-Sr-Cu-O superconductors: The connectivity issue
| DE89-000558 | N89-14874
Modified soldered joints of current-carrying superconductors
| DE88-703754 | N89-14878
Composite ceramic superconducting filaments for superconducting cable
| AD-A198657 | N89-14888
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
| NASA-CR-181724 | N89-14896

**SUPERCRITICAL AIRFOILS**
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight
| NASA-CR-4212 | N89-14821

**SUPERSONIC AIRCRAFT**
Passive venting technique for shallow cavities
| NASA-CASE-LAR-14031-1 | N89-14232
Passive venting technique for shallow cavities
| NASA-CASE-LAR-13875-1 | N89-14233

**SUPERSONIC COMBUSTION**
Effect of heat release on the spatial stability of a supersonic reacting mixing layer
| NASA-CR-181753 | N89-14402

**SUPERSONIC COMBUSTION RAMJET ENGINES**
Modeling of hydrogen-air diffusion flame N89-14913

**SUPPORT SYSTEMS**
The integrated diagnostic support system N89-14745

**SURFACE CRACKS**
The influence of porosity on short fatigue crack growth at large strain amplitudes
| AD-A198477 | N89-14464

**SURFACE ENERGY**
Textural evolution of partially-molten planetary materials in microgravity N89-15037

**SURFACE FINISHING**
Experiments with three identical ultraprecision machine tools
| DE88-016324 | N89-14445

**SURFACE PROPERTIES**
Study of high temperature failure mechanisms in ceramics
| AD-A198375 | N89-14324
RF surface resistance of YBa2Cu3O(7-x) thin films N89-14347
Simulation studies for surfaces and materials strength
| NASA-CR-183378 | N89-14824
Texture-based cloud classification N89-14931

**SURFACE REACTIONS**
Adsorption of chlorine on clean and on oxygen pre-exposed Al(3)
| AD-A198005 | N89-14280
VAMAS surface chemical analysis standard data transfer format with skeleton decoding programs
| NPL-DMA(A)-164 | N89-14724
Molecular beam studies of surface phonons and gas surface interactions
| AD-A198435 | N89-14826

**SURFACE ROUGHNESS EFFECTS**
Specular reflection coefficient of snow at 10, 35 and 94 GHz as a function of grazing angle (Oberjettenberg-Campaign)
| FEL-1988-01 | N89-14495

**SURFACE TEMPERATURE**
The role of thermoelastic effects in the scuffing failure of rolling/sliding EHD contacts
| AD-A198475 | N89-14447
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
| AD-A198653 | N89-14484

**SURFACE WAVES**
Feasibility study for the development of a joint surge and wave model
| PB88-230917 | N89-14652

**SURGES**
Transient behaviors in chemical reactions: Nanosecond infrared spectroscopy, chemically pumped visible and near-IR lasers
| AD-A198484 | N89-14286
Feasibility study for the development of a joint surge and wave model
| PB88-230917 | N89-14652

**SURVEYS**
Geomagnetic survey of the Netherlands, reduced to 1985
| KNMI-TR-109 | N89-14632
Comparative study of career development and training programs N89-14927
A survey of chemical information systems
| NASA-CR-184531 | N89-14971
**SWITCHES**
Basic studies of gases for fast switches
| AD-A198641 | N89-14383
Surface flashover threshold and switched fields of photoconductive semiconductor switches
| DE88-011618 | N89-14876
**SWITCHING**
Basic studies of gases for fast switches
| AD-A198641 | N89-14383
Surface flashover threshold and switched fields of photoconductive semiconductor switches
| DE88-011618 | N89-14876
Transport and junction physics of semiconductor-metal eutectic composites
| AD-A198480 | N89-14884
**SWITCHING CIRCUITS**
STU-3 system level description and network applications, revision
| AD-A198514 | N89-14363
**SYMMETRY**
On the labeling and symmetry adaptation of the solvable finite groups representations
| DE88-703954 | N89-14812
**SYNCHRONISM**
Analysis of FDDI synchronous traffic delays
| NASA-CR-183223 | N89-14695
Fault-tolerant distributed algorithms for agreement and election
| AD-A198416 | N89-14718
**SYNOPTIC METEOROLOGY**
Synoptic and chemical evolution of the Antarctic vortex in winter and spring, 1987 N89-14563
**SYNTHESIS (CHEMISTRY)**
Studies of metal beta-diketonates by reversed-phase high performance liquid chromatography N89-14268
Electrochemical synthesis of barium cuprate
| NASA-TT-20327 | N89-14271
Powerful photogenerated reducing agents
| AD-A197949 | N89-14279
A synthetic route to organic aerogels: Mechanism, structure, and properties
| DE88-017112 | N89-14317
Synthesis of new polynitropolyhedranes
| AD-A198320 | N89-14323
Synthesis of energetic single phase and multi-phase polymers
| AD-A198431 | N89-14325
Polysilylated unsaturated molecules
| AD-A198492 | N89-14328
The synthesis and structure of polyphosphazenes
| AD-A198519 | N89-14329
The synthesis of carborane-oxetane monomers and their polymerization
| AD-A198596 | N89-14330
Polyphenylquinoxalines containing alkylenedioxy groups
| NASA-CASE-LAR-13601-1-CU | N89-14337
How to make a comet N89-15035
**SYSTEM IDENTIFICATION**
Extension and validation of a method for locating damaged members in large space trusses N89-14925
**SYSTEMS ANALYSIS**
Spacelab system analysis: A study of communications systems for advanced launch systems
| NASA-CR-183515 | N89-14248
NAVSPASUR system performance analysis
| AD-A198848 | N89-14252
Spacelab system analysis: A study of the Marshall Avionics System Testbed (MAST)
| NASA-CR-183516 | N89-14354
ETX-I: First-generation single-shaft electric propulsion system program. Volume 2: Battery
| DE89-000079 | N89-14378
Distributed diagnostic performance reporting and analysis N89-14762
Guidelines for preparation of diagnostic requirements N89-14765
GDS: An intelligent diagnostic software shell N89-14766
Artificial intelligence in test program development N89-14769
SDI (Strategic Defense Initiative): Technology, survivability and software
| PB88-236245 | N89-14811
Commercial objectives, technology transfer, and systems analysis for fusion power development N89-14851
Self-adaptive databases
| AD-A197883 | N89-14944
USL/DBMS NASA/PC R and D project system design standards
| NASA-CR-184544 | N89-14984
USL/DBMS NASA/PC R and D project system testing standards
| NASA-CR-184545 | N89-14985
**SYSTEMS ENGINEERING**
The effect of transmission design on force-controlled manipulator performance
| AD-A198131 | N89-14689
Modern computer-aided tools for high-resolution weapons system engineering
| AD-A197855 | N89-14710
RADC (Rome Air Development Center) system/software requirements engineering testbed research and development program
| AD-A197858 | N89-14711
Composing data and process descriptions in the design of software systems
| AD-A198096 | N89-14714
DEH (Directorates of Engineering and Housing) automated graphics guide: Selection, acquisition, implementation, and management
| AD-A198489 | N89-14721
Use of laser diodes for analog fiber optic diagnostics systems
| DE88-017012 | N89-14833
**SYSTEMS INTEGRATION**
Design of an obstacle avoidance system for AIMS
| DE88-016783 | N89-14446
IMAT (Integrated Multidisciplinary Analysis Tool) user's guide for the VAX/VMS computer
| NASA-TM-101500 | N89-14475
The B-1B central integrated test system expert parameter system N89-14763
System integration of knowledge-based maintenance aids N89-14768
**SYSTEMS MANAGEMENT**
Northeast Artificial Intelligence Consortium annual report 1986. Volume 3: Distributed artificial intelligence for communication network management
| AD-A197957 | N89-14774

## T

**T TAURI STARS**
The circumstellar envelopes of young stellar objects and emission line stars N89-15066
**TANDEM MIRRORS**
High temperature blankets for non-electrical/electrical applications of fusion reactors
| DE88-017307 | N89-14857
**TASKS**
Liquid Rocket Booster (LRB) for the Space Transportation System (STS) systems study. Study plan
| NASA-CR-179401 | N89-14249
Mental models for time displayed tasks
| AD-A198536 | N89-14682
**TECHNOLOGIES**
Interactive access to scientific and technological factual databases worldwide
| DE88-016172 | N89-14943
**TECHNOLOGY ASSESSMENT**
Assessment of satellite communications quality study. Addendum 1: Impact of propagation delay on data transmission
| NASA-CR-182229 | N89-14369
Crystalline silicon photovoltaic cell technology: Meeting the challenge for utility power
| DE89-000439 | N89-14500
Starpower: The US and the international quest for fusion energy, contractor documents
| PB88-214663 | N89-14639
Technology and physics implications of oscillating-field current drive in reversed-field pinches
| DE89-000388 | N89-14861
Social sciences and space exploration
| EP-192 | N89-14895
On 3480 class tape cartridge drives and archival data storage: Technology assessment report
| PB88-233135 | N89-14939
**TECHNOLOGY TRANSFER**
Commercial objectives, technology transfer, and systems analysis for fusion power development N89-14851
Welcome to Ames Research Center (1987 forum on Federal technology transfer)
| NASA-TM-100088 | N89-14995
Research and technology utilization
| DE88-016749 | N89-14996
Technology transfer: Transferring Federal R and D results for domestic commercial utilization
| DE89-000419 | N89-14997
**TECHNOLOGY UTILIZATION**
Exploration in the field of expert systems. Report on the project Expert 01
| AD-1987-1271 | N89-14729
Strategy for D/He-3 fusion development N89-14846
Commercial objectives, technology transfer, and systems analysis for fusion power development N89-14851
Research and technology utilization
| DE88-016749 | N89-14996
**TECTONICS**
NASA geodynamics program summary report, 1979-1987 progress and future outlook
| NASA-TM-4065 | N89-14476
Determination of convergence rates across the Ventura Basin, Southern California, using GPS and historical triangulation
| NASA-CR-183014 | N89-14624
**TELECOMMUNICATION**
ELF (Extremely Low Frequency) communication system ecological monitoring program: Electromagnetic field measurements and engineering support, 1987
| AD-A198303 | N89-14360
Mental models for time displayed tasks
| AD-A198536 | N89-14682
Random access algorithms for multiuser computer communication networks
| AD-A198090 | N89-14713
Northeast Artificial Intelligence Consortium annual report 1986. Volume 3: Distributed artificial intelligence for communication network management
| AD-A197957 | N89-14774
**TELEMETRY**
Possible measurement errors in calibrated AVHRR (Advanced Very High Resolution Radiometer) data
| AD-A198342 | N89-14414
Knowledge-based analysis of telemetry data on the Hubble space telescope N89-14751
**TELEOPERATORS**
Design of an obstacle avoidance system for AIMS
| DE88-016783 | N89-14446
Man-robot symbiosis: A framework for cooperative intelligence and control
| DE89-000430 | N89-14687
**TELEPHONY**
Assessment of satellite communications quality study. Addendum 1: Impact of propagation delay on data transmission
| NASA-CR-182229 | N89-14369
**TELESCOPES**
Multi-object astronomical spectroscopy with optical fibres N89-15048
A hard X-ray spectrometer for high angular resolution observations of cosmic sources
| DE88-017005 | N89-15068
**TEMPERATURE CONTROL**
Infrared temperature monitoring and control of final solder-joint temperature on flat flex cables
| DE89-000409 | N89-14349
Capillary heat transport and fluid management device
| NASA-CASE-MFS-28217-1 | N89-14392
**TEMPERATURE DEPENDENCE**
Extinction and backscatter measurements of Antarctic PSC's, 1987: Implications for particle and vapor removal N89-14532
The chemistry of Antarctic ozone 1960-1987 N89-14604
**TEMPERATURE DISTRIBUTION**
Multicolor pyrometer for materials processing in space, phase 2
| NASA-CR-183358 | N89-14406
**TEMPERATURE EFFECTS**
Cyclic deformation, damage, and effects of environment in the Ni3Al ordered alloy at elevated temperatures
| AD-A198500 | N89-14300
Two-bar thermal ratchetting of annealed 2.25Cr-1Mo steel N89-14304
The effect of high heating rate on the pyrolysis of polymeric and composite materials
| AD-A198052 | N89-14319
Temperature effect on stress concentration around circular hole in a composite material specimen representative of X-29A forward-swept wing aircraft
| NASA-CR-179439 | N89-14456
The QBO and interannual variation in total ozone N89-14584
Crystal growth of CdTe in space and thermal field effects on mass flux and morphology
| NASA-CR-183263 | N89-14868
Electrical conductivity of chondritic meteorites N89-15012
**TEMPERATURE INVERSIONS**
Automatic detection of inversions using sodar
| KNMI-TR-106 | N89-14631

**TEMPERATURE MEASUREMENT**
Infrared temperature monitoring and control of final solder-joint temperature on flat flex cables
| DE89-000409 | N89-14349
Heat flux measurements
| NASA-TM-101428 | N89-14418
Temperature and horizontal wind measurements on the ER-2 aircraft during the 1987 airborne Antarctic ozone experiment N89-14560
**TEMPERATURE PROFILES**
Observational results of microwave temperature profile measurements from the airborne Antarctic ozone experiment N89-14558
**TEMPLATES**
Optical inference machines
| AD-A197880 | N89-14772
**TEMPORAL DISTRIBUTION**
Temporal and spatial distribution of stratospheric trace gases over Antarctica in August and September, 1987 N89-14551
In situ observations of ClO in the Antarctic: Evidence for chlorine catalyzed destruction of ozone N89-14554
**TENSILE CREEP**
Study of high temperature failure mechanisms in ceramics
| AD-A198375 | N89-14324
**TENSILE PROPERTIES**
Fracture behaviour under impact 2
| AD-A198643 | N89-14467
**TENSILE STRESS**
Analysis of ductile-brittle transition temperatures for controlled-rolled, microalloyed, C-Mn-based steels
| AD-A198132 | N89-14298
**TERNARY SYSTEMS**
Ternary solid phase equilibria in the systems (Ag,In,Au)-(Cd,He)-Te
| AD-A198679 | N89-14302
**TERRAIN**
Comparison of the general dynamics ground clobber algorithm with the GCAS and laws algorithms
| AD-A198479 | N89-14226
**TERRESTRIAL RADIATION**
Summary of along-track data from the earth radiation budget satellite for several representative ocean regions
| NASA-RP-1206 | N89-14634
**TEST EQUIPMENT**
The computational structural mechanics testbed architecture. Volume 1: The language
| NASA-CR-178384 | N89-14472
Application developer's tutorial for the CSM testbed architecture
| NASA-CR-181732 | N89-14473
The CSM testbed matrix processors internal logic and dataflow descriptions
| NASA-CR-181742 | N89-14474
**TEST RANGES**
Development and use of interactive displays in real-time ground support research facilities
| NASA-TM-101694 | N89-14683
**TETHERED SATELLITES**
Cosmic dust collection with a sub satellite tethered to a Space Station N89-15010
Low-gravity facilities for Space Station planetology experiments N89-15032
**TETHERING**
A magnetospheric simulation at the Space Station N89-15024
**TEXAS**
The design and protocol of a summertime rainfall enhancement program for West Texas N89-14636
**TEXTURES**
Texture-based cloud classification N89-14931
Textural evolution of partially-molten planetary materials in microgravity N89-15037
**THERAPY**
Correction of acute hypoxia-induced changes in blood coagulation in rabbits N89-14663
**THERMAL ANALYSIS**
Anelastic and thermal properties of ethylene/acrylic acid copolymers partially ionized with transition metals
| DE88-017006 | N89-14316
Thermal analysis system (DSC, TGA, TMA) for oxidation and phase transformation studies of alloys with mestable phase
| AD-A198420 | N89-14415
The role of thermal and lubricant boundary layers in the transient thermal analysis of spur gears
| NASA-TM-101435 | N89-14452
**THERMAL BOUNDARY LAYER**
The role of thermal and lubricant boundary layers in the transient thermal analysis of spur gears
| NASA-TM-101435 | N89-14452
**THERMAL CYCLING TESTS**
Analysis of shell-type structures subjected to time-dependent mechanical and thermal loading
| NASA-CR-183005 | N89-14457
**THERMAL FATIGUE**
Automated fatigue crack growth measurement
| AD-A198642 | N89-14466
**THERMAL SHOCK**
Multilayer plasma coats used as thermal barrier in engines
| ETN-89-93598 | N89-14333
**THERMOCHEMISTRY**
Introduction of the Proceedings of the Tenth Symposium on Biotechnology for Fuels and Chemicals
| DE88-016361 | N89-14667
**THERMODYNAMIC EQUILIBRIUM**
Ternary solid phase equilibria in the systems (Ag,In,Au)-(Cd,He)-Te
| AD-A198679 | N89-14302
Retrieval of atmospheric temperatures and gas volume mixing ratios and column amounts from infrared solar absorption spectra
| PB88-236153 | N89-14622
**THERMODYNAMIC PROPERTIES**
Advanced core technology: Key to subsonic propulsion benefits
| NASA-TM-101420 | N89-14237
Anelastic and thermal properties of ethylene/acrylic acid copolymers partially ionized with transition metals
| DE88-017006 | N89-14316
Variable temperature solid state NMR of side-chain crystalline comb polymers
| AD-A198099 | N89-14322
**THERMODYNAMICS**
Joule Thomson refrigerator
| NASA-CASE-NPO-17143-1-CU | N89-14351
Scientific evaluation and assessment of ASL developed moist atmosphere models for low stratus subclouds
| AD-A198762 | N89-14625
Investigations of the dynamics and thermodynamics of the mesosphere and upper thermosphere at the polar regions
| AD-A198463 | N89-14627
**THERMOGRAPHY**
Multilayer plasma coats used as thermal barrier in engines
| ETN-89-93598 | N89-14333
**THERMOMETERS**
Cryogenic thermometers based on TVO type resistors and their application
| DE88-703755 | N89-14413
**THERMONUCLEAR REACTIONS**
The physics of the high density Z-pinch
| DE88-016147 | N89-14855
**THERMOPLASTIC RESINS**
Polymer powder prepregging: Scoping study N89-14926
**THERMOSETTING RESINS**
Semi-interpenetrating polymer network's of polyimides: Fracture toughness N89-14912
**THERMOSPHERE**
Investigations of the dynamics and thermodynamics of the mesosphere and upper thermosphere at the polar regions
| AD-A198463 | N89-14627
**THIN FILMS**
RF surface resistance of YBa2Cu3O(7-x) thin films N89-14347
Liquid sheet radiator apparatus
| NASA-CASE-LEW-14295-1 | N89-14348
The effect of parasitic absorption losses on light trapping in thin silicon solar cells
| DE89-000457 | N89-14501
Photonic applications of thin film GaAs grown on silicon and insulating substrates by molecular beam epitaxy
| DE88-016975 | N89-14877
**THIN WALLED SHELLS**
Analysis of shell-type structures subjected to time-dependent mechanical and thermal loading
| NASA-CR-183005 | N89-14457
**THREE DIMENSIONAL BODIES**
A 3-D object recognition system using aspect graphs
| AD-A198472 | N89-14720
**THREE DIMENSIONAL FLOW**
Turbofan forced mixer lobe flow modeling. 1: Experimental and analytical assessment
| NASA-CR-4147-PT-1 | N89-14221
Turbofan forced mixer lobe flow modeling. 2: Three-dimensional inviscid mixer analysis (FLOMIX)
| NASA-CR-4147-PT-2 | N89-14222
Simulation of 3-D viscous flow within a multi-stage turbine
| NASA-TM-101376 | N89-14238
**THRUST REVERSAL**
Thrust-reverser flow investigation on a twin-engine transport
| NASA-TP-2856 | N89-14213
Investigation of a moving-model technique for measuring ground effect
| NASA-TM-4080 | N89-14217
**THUNDERSTORMS**
Semi-prognostic tests of cumulus parameterization schemes in the middle latitudes
| PB88-236013 | N89-14639
**TIDES**
Feasibility study for the development of a joint surge and wave model
| PB88-230917 | N89-14652
**TIME DEPENDENCE**
Analysis of shell-type structures subjected to time-dependent mechanical and thermal loading
| NASA-CR-183005 | N89-14457
Temporal trends and transport within and around the Antarctic polar vortex during the formation of the 1987 Antarctic ozone hole N89-14565
**TIME FUNCTIONS**
Computation of canonical correlation and best predictable aspect of future for time series
| NASA-CR-184655 | N89-14810
**TIME LAG**
Analysis of FDDI synchronous traffic delays
| NASA-CR-183223 | N89-14695
**TIME MEASUREMENT**
Laser clocks and near field gravity of rotating objects N89-14911
**TIP SPEED**
Users' manual for the Langley high speed propelier noise prediction program (DFP-ATP)
| NASA-CR-4208 | N89-14820
**TIROS N SERIES SATELLITES**
TIROS/NOAA (television and infrared observation satellite/National Oceanic and Atmospheric Administration) satellites space environment monitor archive tape documentation, 1988 update
| PB88-224613 | N89-14619
**TISSUES (BIOLOGY)**
Holographic recording of deformation waves in muscle tissue N89-14660
**TITANIUM**
Synchronously pumped mode-locked Ti:Al2O3 lasers N89-14344
Residual infrared absorption in Ti:Al2O3 crystals N89-14345
The viscoplastic behavior of SCS6/Ti-15-3 metal matrix composite materials at elevated temperatures N89-14929
**TOKAMAK DEVICES**
Review projects for the US Fusion Program
| DE88-017306 | N89-14856
Panel on high beta and/or high field tokamaks and stellarators
| DE88-017367 | N89-14859
Activities report in plasma physics
| ETN-89-93377 | N89-14864
**TOLERANCES (PHYSIOLOGY)**
Articulated total body model enhancements. Volume 3: Programmer's guide
| AD-A197940 | N89-14688
**TOPOGRAPHY**
FRANK: Some aspects of the processing of observations using the interpretation instrument; measuring methods, instrumental errors and preprocessing of the observations --- FRANK; a system for photographic registration of topography for analog image presentation and map manufacturing
| ETN-89-93338 | N89-14494
**TORCHES**
The effect of torch pressure on analyte response in a 27 MHz inductively coupled plasma
| AD-A198595 | N89-14863
**TOROIDAL PLASMAS**
Edge-plasmas and wall protection in RFPs (Reversed-Field Pinch)
| DE89-000386 | N89-14860
**TOROIDAL SHELLS**
Toroidal pinch experiments in OHTE with a resistive shell
| DE88-017339 | N89-14858
**TOXICITY**
Simplifying complex QSAR's (Quantitative Structure-Activity Relationships) in toxicity studies with multivariate statistics
| PB88-233937 | N89-14614
**TRACE CONTAMINANTS**
Trace analysis by capillary gas chromatography: Theory and methods
| B8811770 | N89-14289
Temporal and spatial distribution of stratospheric trace gases over Antarctica in August and September, 1987 N89-14551
Assessing the risks of trace gases that can modify the stratosphere. Volume 1: Executive summary
| PB88-231055 | N89-14610

Assessing the risks of trace gases that can modify the stratosphere. Volume 6: Technical support documentation production projections
[PB88-231071] N89-14611
Assessing the risks of trace gases that can modify the stratosphere. Volume 7: Technical support documentation atmospheric science papers
[PB88-231089] N89-14612
Assessing the risks of trace gases that can modify the stratosphere. Volume 8: Technical support documentation ozone depletion and plants
[PB88-231097] N89-14613
The effects of biomass burning on the concentration of trace gases in the atmosphere N89-14904

**TRACE ELEMENTS**
Gas chromatographic and spectroscopic studies of cobalt(II) and other selected transition metal chelates of tetradentate beta-ketoenamines N89-14269
Mixing ratios of trace gases in the austral polar atmosphere during August and September of 1987 N89-14556
Trace gas measurements from whole air samples collected over the Antarctic continent N89-14561
Observations of stratospheric source gas profiles during the Arctic winter N89-14573
Rocket- and aircraft-borne trace gas measurements in the winter polar stratosphere N89-14574

**TRACKING (POSITION)**
Automatic detection, tracking and sensor integration
[AD-A198347] N89-14361

**TRACKING FILTERS**
Automatic detection, tracking and sensor integration
[AD-A198347] N89-14361

**TRAINING ANALYSIS**
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
[NASA-CR-181724] N89-14896
Comparative study of career development and training programs N89-14927

**TRAINING DEVICES**
Development and demonstration of Microcomputer Intelligence for Technical Training (MITT)
[AD-A197971] N89-14775
The USL NASA PC R and D interactive presentation development system
[NASA-CR-184539] N89-14979

**TRAINING SIMULATORS**
Development and demonstration of Microcomputer Intelligence for Technical Training (MITT)
[AD-A197971] N89-14775

**TRAJECTORY ANALYSIS**
Photochemical trajectory modelling studies of the 1987 Antarctic spring vortex N89-14559

**TRANSFORMERS**
Transverter assembly for the advanced instrumentation radar
[DE89-001036] N89-14357

**TRANSIENT HEATING**
The role of thermal and lubricant boundary layers in the transient thermal analysis of spur gears
[NASA-TM-101435] N89-14452

**TRANSIENT RESPONSE**
Eye and head motion during head turns in spaceflight
[NASA-TM-100466] N89-14676

**TRANSITION FLOW**
Two-equation low-Reynolds-number turbulence modeling of transitional boundary layer flows characteristic of gas turbine blades N89-14218

**TRANSITION METALS**
Anelastic and thermal properties of ethylene/acrylic acid copolymers partially ionized with transition metals
[DE88-017006] N89-14316

**TRANSITION TEMPERATURE**
Analysis of ductile-brittle transition temperatures for controlled-rolled, microalloyed, C-Mn-based steels
[AD-A198132] N89-14298
Critical fields and characteristic lengths in copper oxide superconductors
[DE89-000543] N89-14872

**TRANSMISSION LINES**
Combining signals of widely differing bit rates on fiber optic subscriber lines
[PB88-210067] N89-14352
Current induced by HEMP (High-Altitude Electromagnetic Pulse) on wire above ground
[PB88-212048] N89-14353
An asymptotic analysis of a class of nonlinear hyperbolic equations
[ETN-89-93352] N89-14796

**TRANSONIC FLOW**
Flux vector splitting of the one-dimensional Euler equations
[PB88-210109] N89-14214
Navier-Stokes calculations of transonic flows past cavities
[NASA-CR-4210] N89-14401

**TRANSONIC SPEED**
Transonic aeroelastic analysis of launch vehicle configurations
[NASA-CR-4186] N89-14215

**TRANSONIC WIND TUNNELS**
Two-dimensional aerodynamic characteristics of the OLS/TAAT airfoil
[NASA-TM-89435] N89-14216

**TRANSPORT AIRCRAFT**
Thrust-reverser flow investigation on a twin-engine transport
[NASA-TP-2856] N89-14213

**TRANSPORT PROPERTIES**
Benchmark solutions for the galactic ion transport equations with spatial and energy coupling N89-14907

**TRANSPORT THEORY**
Transport into the south polar vortex in early spring N89-14567
Universal limiter for transient interpolation modeling of the advective transport equations: The ULTIMATE conservative difference scheme
[NASA-TM-100916] N89-14794
Sediment-transport experiments in zero-gravity N89-15020

**TRAPPED PARTICLES**
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
[AD-A198361] N89-14439

**TRAPPING**
Analysis of hydrogen diffusion and trapping in a 13 percent chromium martensitic stainless steel
[NPL-DMA(A)-158] N89-14301
The effect of parasitic absorption losses on light trapping in thin silicon solar cells
[DE89-000457] N89-14501

**TREADMILLS**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
[AD-A197472] N89-14668

**TRIANGULATION**
On the connection of geodetic point fields in Reseau European Trigonometrique (RETRIG) and related tests for model errors
[ETN-89-93327] N89-14485
Determination of convergence rates across the Ventura Basin, Southern California, using GPS and historical triangulation
[NASA-CR-183014] N89-14624

**TRIBOLOGY**
Tribological characteristics of coatings on aluminium and its alloys N89-14290

**TRITIUM**
Helium-3 blankets for tritium breeding in fusion reactors N89-14844

**TROPICAL REGIONS**
A study for systematic errors of the GLA forecast model in tropical regions
[NASA-TM-101194] N89-14651

**TROPOPAUSE**
Decending motion of particle and its effect on ozone hole chemistry N89-14570

**TROPOSPHERE**
Airborne measurements of tropospheric ozone destruction and particulate bromide formation in the Arctic N89-14582
Use of operational analyses to study the dynamics of troposphere-stratosphere interactions in polar regions N89-14597
Stratospheric feedback from continued increases in tropospheric methane N89-14606
Long term studies of the refractive index structure parameter in the troposphere and stratosphere
[AD-A198313] N89-14626

**TRUSSES**
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
[NASA-CR-181724] N89-14896
End-effector - joint conjugates for robotic assembly of large truss structures in space: A second generation N89-14898
Extension and validation of a method for locating damaged members in large space trusses N89-14925

**TUBE HEAT EXCHANGERS**
Heat exchanger optimization N89-14391

**TUNGSTEN ALLOYS**
Low temperature heat capacities of several high strength materials
[AD-A198300] N89-14299

**TURBINE BLADES**
Two-equation low-Reynolds-number turbulence modeling of transitional boundary layer flows characteristic of gas turbine blades N89-14218
Multilayer plasma coats used as thermal barrier in engines
[ETN-89-93598] N89-14333
A numerical simulation of the flow field and heat transfer in a rectangular passage with a turbulence promoter
[AD-A198579] N89-14400
Heat flux measurements
[NASA-TM-101428] N89-14418

**TURBINE ENGINES**
Plotting component maps in the Navy/NASA Engine Program (NNEP): A method and its usage
[NASA-TM-101433] N89-14239
A review of failure models for unidirectional ceramic matrix composites under monotonic loads
[NASA-TM-101421] N89-14470

**TURBINE PUMPS**
Heat flux measurements
[NASA-TM-101428] N89-14418
Dynamic analysis of nonlinear rotor-housing systems
[NASA-CR-184611] N89-14449

**TURBOCOMPRESSORS**
Simulation of 3-D viscous flow within a multi-stage turbine
[NASA-TM-101376] N89-14238

**TURBOFAN ENGINES**
Advanced core technology: Key to subsonic propulsion benefits
[NASA-TM-101420] N89-14237

**TURBOFANS**
Turbofan forced mixer lobe flow modeling. 2: Three-dimensional inviscid mixer analysis (FLOMIX)
[NASA-CR-4147-PT-2] N89-14222

**TURBOMACHINERY**
Simulation of 3-D viscous flow within a multi-stage turbine
[NASA-TM-101376] N89-14238

**TURBOPROP ENGINES**
Parametric studies of advanced turboprops
[NASA-TM-101389] N89-14465

**TURBULENCE**
Effects of core turbulence on jet excitability
[NASA-TM-101405] N89-14403

**TURBULENT BOUNDARY LAYER**
Energy dissipation of monochromatic sea waves in the turbulent boundary layer
[KNMI-TR-104] N89-14657
An investigation of turbulence models N89-14905
Aeolian processes aboard a Space Station: Saltation and particle trajectory analysis N89-15039

**TURBULENT FLOW**
Numerical methods for turbulent flow N89-14928

**TURBULENT HEAT TRANSFER**
A numerical simulation of the flow field and heat transfer in a rectangular passage with a turbulence promoter
[AD-A198579] N89-14400

**TURBULENT JETS**
Dynamic combustion studies using advanced optical diagnostics. Volume 2: Tabulated data
[AD-A198025] N89-14281
Underexpanded noncondensing turbulent gas jets in liquids
[AD-A197939] N89-14396

**TWO DIMENSIONAL BODIES**
Two-dimensional aerodynamic characteristics of the OLS/TAAT airfoil
[NASA-TM-89435] N89-14216
Monolithic two-dimensional surface-emitting arrays of GaAs/AlGaAs diode lasers N89-14343

**TWO DIMENSIONAL FLOW**
Experimental results for a two-dimensional supersonic inlet used as a thrust deflecting nozzle
[NASA-TM-83439] N89-14386
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet
[AD-A198360] N89-14399

**TWO DIMENSIONAL MODELS**
A numerical simulation of the full two-dimensional electrothermal de-icer pad
[NASA-CR-4194] N89-14235
Formation of polar stratospheric clouds simulated in a two dimensional model of the atmosphere N89-14529

**TWO FLUID MODELS**
Laser generated large amplitude longitudinal fields in inhomogeneous plasma with second harmonic super density resonances and quasi-uniform coronal oscillations N89-14840

**TWO PHASE FLOW**
Working fluid selection for space-based two-phase heat transport systems
[NASA-CR-183324] N89-14390

## U

**U.S.S.R.**
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-87-008] N89-14658

An intercomparison of the radium mass standards of the UK and the USSR
[NPL-RS(EXT)-103] N89-14828
The Baksan Neutrino Observatory Soviet-American Gallium Solar Neutrino Experiment
[DE89-000375] N89-15061

**U.S.S.R. SPACE PROGRAM**
Current achievements in cosmonautics
[NASA-TT-20365] N89-14245

**ULTRASONIC FLAW DETECTION**
Development of a contactless optoacoustic method for nondestructive testing. Part 2: Optical excitation of ultrasonic vibrations
[TPD-1987-0-2-PT-2] N89-14454

**ULTRASONIC WAVE TRANSDUCERS**
Ultrasonic depth gauge for liquids under high pressure
[NASA-CASE-LAR-13300-1-CU] N89-14407

**ULTRASONICS**
Ultrasonic depth gauge for liquids under high pressure
[NASA-CASE-LAR-13300-1-CU] N89-14407

**ULTRAVIOLET LASERS**
Study of extreme ultraviolet laser sources for the guiding of particle beams
[DE88-008918] N89-14435
High-energy UV laser experiments
[DE89-000505] N89-14437

**ULTRAVIOLET RADIATION**
Subpicosecond, high-brightness excimer laser systems
[DE88-016239] N89-14430
High-energy UV laser experiments
[DE89-000505] N89-14437
Radiation effects on polymeric materials N89-14914

**ULTRAVIOLET SPECTROSCOPY**
Ultraviolet spectroscopy of meteoric debris: In situ calibration experiments from earth orbit N89-15031

**UNDERWATER ACOUSTICS**
Qualitative aspects of seismograph/ocean bottom interaction
[AD-A198652] N89-14656

**UNITED KINGDOM**
An intercomparison of the radium mass standards of the UK and the USSR
[NPL-RS(EXT)-103] N89-14828

**UNITS OF MEASUREMENT**
Traceability of laser interferometric length measurements
[PB88-225677] N89-14405

**UNIVERSITIES**
Transportable educational programs for scientific and technical professionals: More effective utilization of automated scientific and technical data base systems
[NASA-CR-184507] N89-14947
Transportable, university-level educational programs in interactive information storage and retrieval systems
[NASA-CR-184511] N89-14951
A report on the USL NASA/RECON project. Part 1: The development of a transportable, university level, IS and R educational program
[NASA-CR-184515] N89-14955
An innovative, multidisciplinary educational program in interactive information storage and retrieval
[NASA-CR-184520] N89-14960

**UNSATURATION (CHEMISTRY)**
Polysilylated unsaturated molecules
[AD-A198492] N89-14328

**UNSTEADY AERODYNAMICS**
Numerical analysis of flow through oscillating cascade sections
[NASA-TM-101417] N89-14220
Calculation of the steadily periodic and gust responses of a hingeless rotor helicopter using two-dimensional time domain unsteady aerodynamics N89-14240

**UNSTEADY FLOW**
Navier-Stokes calculations of transonic flows past cavities
[NASA-CR-4210] N89-14401

**UPPER ATMOSPHERE**
Kiruna geophysical data: Data summary Oct. - Dec. 1987
[PB88-236633] N89-14623

**USER MANUALS (COMPUTER PROGRAMS)**
Application developer's tutorial for the CSM testbed architecture
[NASA-CR-181732] N89-14473
IMAT (Integrated Multidisciplinary Analysis Tool) user's guide for the VAX/VMS computer
[NASA-TM-101500] N89-14475
User's guide for executing OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms, version 4) with CBM-4 (Carbon-Bond Mechanism-4)
[PB88-221965] N89-14609
User's guide for the Nimbus 7 Scanning Multichannel Microwave Radiometer (SMMR) CELL-ALL tape
[NASA-RP-1210] N89-14648
Articulated total body model enhancements. Volume 3: Programmer's guide
[AD-A197940] N89-14688
A user's manual for the Loaded Microstrip Antenna Code (LMAC)
[NASA-CR-184596] N89-14725
Expert systems to give installation advice for UNIX 4.2BSD and to help connect a terminal to a computer N89-14755
Users' manual for the Langley high speed propeller noise prediction program (DFP-ATP)
[NASA-CR-4208] N89-14820
LARCMACS: A TEX macro set for typesetting NASA reports
[NASA-TM-101522] N89-14994

**USER REQUIREMENTS**
The man/machine interface in information retrieval: Providing access to the casual user
[NASA-CR-184512] N89-14952
Concepts and implementations of natural language query systems
[NASA-CR-184514] N89-14954
USL NASA/RECON project presentations at the 1985 ACM Computer Science Conference: Abstracts and visuals
[NASA-CR-184522] N89-14962
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems. Presentation visuals
[NASA-CR-184524] N89-14964
An hierarchical approach to performance evaluation of expert systems
[NASA-CR-184527] N89-14967

## V

**V/STOL AIRCRAFT**
Experimental results for a two-dimensional supersonic inlet used as a thrust deflecting nozzle
[NASA-TM-83439] N89-14386

**VACUUM MELTING**
Monochromatic imaging studies of a low pressure arc burning on molten Inconel 718 alloy electrodes during vacuum arc remelting
[DE88-012855] N89-14292

**VALVES**
Development of a rotary valve for pulse combustion applications
[PB88-250568] N89-14444

**VAPOR DEPOSITION**
Diamond chemical vapor deposition apparatus
[NASA-TT-20380] N89-14870

**VAPOR PHASES**
Reactions of metal ions and their clusters in the gas phase using laser ionization-Fourier transform mass spectrometry
[DE88-017281] N89-14431
Stability and photochemistry of ClO dimers formed at low temperature in the gas phase N89-14600

**VAPOR PRESSURE**
Laboratory studies of HNO3/H2O mixtures at low temperatures N89-14533

**VAPORIZING**
Use of time-resolved techniques for studying shock-induced vaporization
[DE88-017168] N89-14395
Volatilization-fractionation of silicates related to chondrite composition N89-15036

**VAPORS**
Spontaneous and induced coherent radiation generated in atomic vapor
[AD-A198060] N89-14282
Filter measurements of chemical composition during the airborne Antarctic ozone experiment N89-14526

**VARIABILITY**
The evolution of AAOE observed constituents with the polar vortex N89-14568
Variations of total ozone in the north polar region as seen by TOMS N89-14571
Springtime surface ozone fluctuations at high Arctic latitudes and their possible relationship to atmospheric bromine N89-14581

**VARIANCE (STATISTICS)**
Variance components estimation in two dimensional geodetic networks
[ETN-89-93332] N89-14489
Statistical model of environmental contaminants using variance spectrum analysis
[PB88-235130] N89-14615

**VAX COMPUTERS**
IMAT (Integrated Multidisciplinary Analysis Tool) user's guide for the VAX/VMS computer
[NASA-TM-101500] N89-14475
Running a large Monte Carlo Program in a farm of MicroVAX-II computers under VAXELIN
[DE88-012761] N89-14732

**VEINS**
Systemic hemodynamic shifts in hypoxia N89-14665

**VELOCITY MEASUREMENT**
Application of Fabry-Perot velocimeter to high-speed experiments
[DE88-016269] N89-14410

**VENTING**
Passive venting technique for shallow cavities
[NASA-CASE-LAR-14031-1] N89-14232
Passive venting technique for shallow cavities
[NASA-CASE-LAR-13875-1] N89-14233

**VERBAL COMMUNICATION**
The use of think aloud verbal protocols for the identification of mental models
[DE88-015180] N89-14935

**VERTICAL DISTRIBUTION**
The threee-dimensional morphology of the Antarctic ozone hole N89-14509
Seasonal and temporal changes in the vertical profiles of polar stratospheric ozone: 1978-1986 N89-14513
Ozone profiles above Palmer Station, Antarctica N89-14518
Total ozone, ozone vertical distributions, and stratospheric temperatures at South Pole, Antarctica, in 1986 and 1987 N89-14519
Lidar observations of polar stratospheric clouds at McMurdo, Antarctica, during NOZE-2 N89-14540
Turbulence structure of Arctic stratus clouds derived from measurements and simulations
[DFVLR-FB-88-29] N89-14633

**VERY LARGE SCALE INTEGRATION**
Parallel processing techniques for the simulation of MOS VLSI circuits using waveform relaxation
[AD-A197879] N89-14734
Expert system on a chip: An engine for real-time approximate reasoning N89-14771

**VERY LONG BASE INTERFEROMETRY**
Very Long Baseline Interferometry (VLBI): Relativity and geodesy
[ETN-89-93337] N89-14493

**VESTIBULAR TESTS**
Eye and head motion during head turns in spaceflight
[NASA-TM-100466] N89-14676
Studies of the horizontal vestibulo-ocular reflex on STS 7 and 8
[NASA-TM-100468] N89-14677

**VIBRATION**
A walk along interfaces --- aeroelasticity
[B8817008] N89-14223
Light weight high performance manipulators
[AD-A198647] N89-14448
GREEDI: The computerization of the DOE/DOD environmental data bank
[DE88-014965] N89-14941

**VIBRATION DAMPING**
Control of the flexible modes of an advanced technology geostationary platform N89-14902

**VIBRATIONAL SPECTRA**
Vibration spectra of silica near 2400 K: Measurement and molecular dynamics simulation
[DE88-015925] N89-14314

**VIDEO EQUIPMENT**
The USL NASA PC R and D interactive presentation development system
[NASA-CR-184539] N89-14979

**VISCOPLASTICITY**
A viscoplastic constitutive model for anisotropic metals at high temperature N89-14305
Finite element formulation for nonlinear viscoplastic material using a Q-model
[PB88-213764] N89-14776
The viscoplastic behavior of SCS6/Ti-15-3 metal matrix composite materials at elevated temperatures N89-14929

**VISCOUS FLOW**
Simulation of 3-D viscous flow within a multi-stage turbine
[NASA-TM-101376] N89-14238

**VISIBILITY**
Field tests and experiments on visibility modification
[AD-A197956] N89-14643

**VISIBLE SPECTRUM**
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic N89-14577

**VISUAL ACUITY**
Effects of low and high oxygen tensions and related respiratory conditions on visual performance: A literature review
[AD-A198688] N89-14669
Further investigation of contrast sensitivity and visual acuity in pilot detection of aircraft
[AD-A198434] N89-14680

**VISUAL DISCRIMINATION**
Further investigation of contrast sensitivity and visual acuity in pilot detection of aircraft
[AD-A198434] N89-14680
**VISUAL PERCEPTION**
Effects of low and high oxygen tensions and related respiratory conditions on visual performance: A literature review
[AD-A198688] N89-14669
Studies of the horizontal vestibulo-ocular reflex on STS 7 and 8
[NASA-TM-100468] N89-14677
Polygons, stars, and clusters: An investigation of polygon displays
[AD-A198430] N89-14719
**VITREOUS MATERIALS**
Vibration spectra of silica near 2400 K: Measurement and molecular dynamics simulation
[DE88-015925] N89-14314
**VOICE COMMUNICATION**
Automatic speaker recognition system
[AD-A197980] N89-14358
STU-3 system level description and network applications, revision
[AD-A198514] N89-14363
**VOICE DATA PROCESSING**
Description of the RSG-10 noise data base --- speech recognition/communication
[IZF-1988-03] N89-14945
**VOLATILITY**
Volatilization-devolatilization reactions N89-15014
**VOLTAGE CONVERTERS (DC TO DC)**
Transverter assembly for the advanced instrumentation radar
[DE89-001036] N89-14357
**VORTEX FILAMENTS**
On the origin of steep edges and filaments in vorticity and potential vorticity fields N89-14593
**VORTICES**
Dynamics of unbound vortices in the 2-dimensional XY and anisotropic Heisenberg models
[DE89-000371] N89-14394
The breakup of the Southern Hemisphere spring polar ozone and temperature minimums from 1979 to 1987 N89-14506
Photochemical trajectory modelling studies of the 1987 Antarctic spring vortex N89-14559
Synoptic and chemical evolution of the Antarctic vortex in winter and spring, 1987 N89-14563
Temporal trends and transport within and around the Antarctic polar vortex during the formation of the 1987 Antarctic ozone hole N89-14565
Small scale structure and mixing at the edge of the Antarctic vortex N89-14566
Transport into the south polar vortex in early spring N89-14567
Diagnostic studies of the 1987 Antarctic spring vortex N89-14587
Polar vortex dynamics N89-14588
Evolution of the Antarctic polar vortex in spring: Response of a GCM to a prescribed Antarctic ozone hole N89-14589
On the origin of steep edges and filaments in vorticity and potential vorticity fields N89-14593
High-resolution dynamical modelling of the Antarctic stratospheric vortex N89-14594
**VORTICITY**
Polar vortex dynamics N89-14588

## W

**WAKES**
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight
[NASA-CR-4212] N89-14821
An investigation of turbulence models N89-14905
**WALLS**
Transient magnetohydrodynamic liquid-metal flows in a rectangular channel with a moving conducting wall
[AD-A197308] N89-14841
**WARNING SYSTEMS**
Evaluation of the improved OV-1D anti-icing system
[AD-A198438] N89-14225
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899
A flight test design for studying airborne applications of air to ground duplex data link communications N89-14924
**WATER HEATING**
Iodine sorption study on the proposed use of Viton A in a shuttle galley water accumulator
[NASA-TM-100467] N89-14691
**WATER TREATMENT**
A solar photochemical process for destroying organics in water
[DE89-000503] N89-14277
**WATER VAPOR**
In-situ measurements of total reactive nitrogen, total water vapor, and aerosols in polar stratospheric clouds in the Antarctic stratosphere N89-14531
Large scale features of the atmospheric water vapor transport over the Amazon Region N89-14620
**WATER WAVES**
Feasibility study for the development of a joint surge and wave model
[PB88-230917] N89-14652
Energy dissipation of monochromatic sea waves in the turbulent boundary layer
[KNMI-TR-104] N89-14657
**WAVE EQUATIONS**
An asymptotic analysis of a class of nonlinear hyperbolic equations
[ETN-89-93352] N89-14796
**WAVE INTERACTION**
Feasibility study for the development of a joint surge and wave model
[PB88-230917] N89-14652
**WAVE PROPAGATION**
Phase transformation and enhanced nuclear resonance in acoustics N89-14816
**WAVEGUIDE LASERS**
Investigation of RF excited CW CO2 waveguide lasers local oscillator - RF excitation
[NASA-CR-183344] N89-14427
**WAVEGUIDES**
Transverse effects of a waveguide coupling slot
[DE89-000340] N89-14356
**WEAPON SYSTEMS**
Modern computer-aided tools for high-resolution weapons system engineering
[AD-A197855] N89-14710
The integrated diagnostic support system N89-14745
Expert systems in higher echelon maintenance activities N89-14761
The B-1B central integrated test system expert parameter system N89-14763
Guidelines for preparation of diagnostic requirements N89-14765
SDI (Strategic Defense Initiative): Technology, survivability and software
[PB88-236245] N89-14811
**WEAR**
Tribological characteristics of coatings on aluminium and its alloys N89-14290
**WEAR TESTS**
Some composite bearing and seal materials for gas turbine applications: A review
[NASA-TM-101451] N89-14338
**WEATHER FORECASTING**
Diagnostic studies of the 1987 Antarctic spring vortex N89-14587
The data collection component of the Hanford Meteorology Monitoring Program
[DE89-000404] N89-14641
Fitting of Meteosat information into meteorological decision making
[KNMI-TR-108] N89-14650
A study for systematic errors of the GLA forecast model in tropical regions
[NASA-TM-101194] N89-14651
**WEIGHTLESSNESS**
Eye and head motion during head turns in spaceflight
[NASA-TM-100466] N89-14676
**WETTABILITY**
Effects of crucible wetting during solidification of immiscible Pb-Zn
[NASA-TM-101372] N89-14341
**WHITE NOISE**
Equivalent linearization for fatigue life estimates of a nonlinear structure N89-14919
**WIND (METEOROLOGY)**
Global impact of the Antarctic ozone hole: Simulations with a 3-D chemical transport model N89-14586
Diagnostic studies of the 1987 Antarctic spring vortex N89-14587
Evolution of the Antarctic polar vortex in spring: Response of a GCM to a prescribed Antarctic ozone hole N89-14589
The data collection component of the Hanford Meteorology Monitoring Program
[DE89-000404] N89-14641
A study of a rapid cyclogenesis event during gale
[AD-A198555] N89-14645
The initiation of grain movement by wind N89-15029
**WIND DIRECTION**
Some wind characteristics of Kahe Point, O'ahu and vicinity
[AD-A197969] N89-14644
The measurement of gustiness at routine wind stations: A review
[KNMI-WR-87-11] N89-14646
**WIND EFFECTS**
Dynamical adjustments in the planetary boundary layer N89-14618
**WIND MEASUREMENT**
The measurement of gustiness at routine wind stations: A review
[KNMI-WR-87-11] N89-14646
Description of the Cabauw (Netherland) turbulence dataset 1977-1979
[KNMI-TR-105] N89-14647
**WIND SHEAR**
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
[NASA-CR-181724] N89-14896
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899
**WIND TUNNEL APPARATUS**
Optical fiber data transfer system
[NASA-CR-181704] N89-14376
**WIND TUNNEL MODELS**
Two-dimensional aerodynamic characteristics of the OLS/TAAT airfoil
[NASA-TM-89435] N89-14216
**WIND TUNNEL TESTS**
Sediment-transport experiments in zero-gravity N89-15020
The initiation of grain movement by wind N89-15029
**WIND TUNNELS**
Transient heat transfer from shrinking LOX-drop N89-14916
Physics of windblown particles N89-15000
Small linear wind tunnel saltation experiments: Some experiences N89-15015
Sediment-transport experiments in zero-gravity N89-15020
Design and calibration of the carousel wind tunnel N89-15021
Development and testing of a unique carousel wind tunnel to experimentally determine the effect of gravity and the interparticle force on the physics of wind-blown particles
[WHITE, BRUCE R.] N89-15022
Aeolian processes aboard a Space Station: Saltation and particle trajectory analysis N89-15039
**WIND VARIATIONS**
Some wind characteristics of Kahe Point, O'ahu and vicinity
[AD-A197969] N89-14644
The role of horizontal processes in upper-ocean prediction: A forecast simulation in the Sea of Japan
[AD-A198827] N89-14654
**WIND VELOCITY**
Temperature and horizontal wind measurements on the ER-2 aircraft during the 1987 airborne Antarctic ozone experiment N89-14560
Some wind characteristics of Kahe Point, O'ahu and vicinity
[AD-A197969] N89-14644
The measurement of gustiness at routine wind stations: A review
[KNMI-WR-87-11] N89-14646
**WINTER**
Evolution of polar stratospheric clouds during the Antarctic winter N89-14534
Heterogeneous physicochemistry of the winter polar stratosphere N89-14535
Infrared measurements of column amounts of stratospheric constituents in the Antarctic winter, 1987 N89-14545
Dehydration in the lower Antarctic stratosphere in late winter and spring N89-14564
Wintertime losses of ozone in high northern latitudes N89-14572
Observations of stratospheric source gas profiles during the Arctic winter N89-14573
Rocket- and aircraft-borne trace gas measurements in the winter polar stratosphere N89-14574
In situ observations of ClO in the wintertime Northern Hemisphere: ER-2 aircraft results from 21 N to 61 N latitude N89-14575
CANOZE measurements of the Arctic ozone hole N89-14578
Brewer spectrophotometer measurements in the Canadian Arctic N89-14579
Zone measurements during wintertime in the Arctic. Comparision with recent measurements at the same places are made. Here the 30 hPa Temperatures are shown N89-14580
Evolution of the Antarctic polar vortex in spring: Response of a GCM to a prescribed Antarctic ozone hole N89-14589

**WORKING FLUIDS**
Working fluid selection for space-based two-phase heat transport systems
[NASA-CR-183324] N89-14390
**WORKLOADS (PSYCHOPHYSIOLOGY)**
Autonomous RPRV navigation, guidance and control
[NASA-CR-179425] N89-14228
Workload for air combat and air traffic controllers
[IZF-1987-32] N89-14230
Perceptual factors in workload: A neuromagnetic study
[AD-A198487] N89-14681
Working in impermeable clothing: Criteria for maximum stress
[IZF-1987-24] N89-14692
**WORKSTATIONS**
General specifications for the development of a USL/DBMS NASA/PC R and D distributed workstation
[NASA-CR-184538] N89-14978

## X

**X RAY DIFFRACTION**
Automation of a Guinier camera for X-ray diffraction
[ETN-89-93350] N89-14419
**X RAY SPECTRA**
Optical spectroscopy of X-ray: Selected active galactic nuclei N89-15049
**X RAY SPECTROSCOPY**
A hard X-ray spectrometer for high angular resolution observations of cosmic sources
[DE88-017005] N89-15068
**X RAYS**
Progress and prospects in soft X-ray holographic microscopy
[DE88-016638] N89-14409
A hard X-ray spectrometer for high angular resolution observations of cosmic sources
[DE88-017005] N89-15068

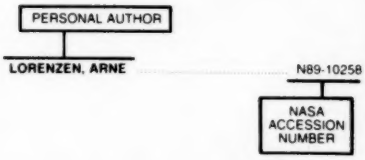
## Y

**YAG LASERS**
The determination of energy transfer rates in the Ho:Tm:Cr:YAG laser material N89-14915
**YTTRIUM**
RF surface resistance of YBa2Cu3O(7-x) thin films N89-14347
**YTTRIUM OXIDES**
Magnetic field penetration into the high temperature superconductor YBa2Cu3O(sub 7-x)
[DE89-000547] N89-14873
**YTTRIUM-ALUMINUM GARNET**
Spectroscopic investigation of the Cr to Tm energy transfer in Yttrium Aluminum Garnet (YAG) crystals N89-14903

## Z

**ZENITH**
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic N89-14577
**ZINC**
Effects of crucible wetting during solidification of immiscible Pb-Zn
[NASA-TM-101372] N89-14341
**ZIRCONIUM**
Oxidation behavior of FeAl + Hf,Zr,B
[NASA-TM-101402] N89-14297
**ZIRCONIUM OXIDES**
Study of the localized vibrations of the hydrogen in solid solution Zr-O by inelastic neutron scattering
[DE88-702945] N89-14866

### Typical Personal Author Index Listing




Listings in this index are arranged alphabetically by personal author. The NASA accession number denotes the number by which the citation is identified.

## A


ABAZOV, A. I. ..... N89-15061
ABDUL-MAHDI, FADHIL S. ..... N89-14290
ABDURASHITOV, D. N. ..... N89-15061
ABUAMARA, HOSAME H. ..... N89-14718
ACHARYA, MUKUND ..... N89-14242
ADAMCZYK, JOHN J. ..... N89-14238
ADAMS, CHARLES R. ..... N89-14941
ADAMS, R. G. ..... N89-14437
ADOLPH, H. G. ..... N89-14325
AGTERBERG, ROB ..... N89-14631
AHMAD, F. ..... N89-14248
N89-14354
AHRENS, THOMAS J. ..... N89-15005
N89-15006
AI, C. S. ..... N89-14753
AIELLO, R. A. ..... N89-14465
AIKIN, ARTHUR C. ..... N89-14503
N89-14509
AKGERMAN, N. ..... N89-14712
AKIN, L. S. ..... N89-14452
AKIYOSHI, H. ..... N89-14592
ALEXANDER, W. M. ..... N89-15007
ALI, MOONIS ..... N89-14753
ALLCOCK, HARRY R. ..... N89-14329
ALLEN, M. ..... N89-14595
ALLIK, TOOMAS H. ..... N89-14883
ALSABBAGH, JAMAL R. ..... N89-14968
ALTIDIS, P. C. ..... N89-14453
ANDERSEN, CARL M. ..... N89-14897
ANDERSON, D. M. ..... N89-15014
ANDERSON, J. ..... N89-14568
ANDERSON, J. G. ..... N89-14554
N89-14575
N89-14583
ANDREWS, MICHAEL D. ..... N89-14252
ANDREWS, SHEILA BRISKIN ..... N89-14684
ANOSOV, O. V. ..... N89-15061
ANTOLOVICH, STEPHEN D. ..... N89-14300
ANTONELLI, DAVID R. ..... N89-14754
APIKYAN, S. A. ..... N89-14790
ARETI, H. ..... N89-14733
ARINGTON, MICHAEL L. ..... N89-14764
ARKHESTOV, G. KH. ..... N89-15069
ARMSTRONG, R. W. ..... N89-14298
ARNOLD, F. ..... N89-14574
ARORA, J. S. ..... N89-14458
ARVIZU, D. E. ..... N89-14500
ASAY, J. R. ..... N89-14395
ASHBY, GEORGE C., JR. ..... N89-14423
ATAC, R. ..... N89-14733
ATHANS, MICHAEL ..... N89-14377
ATKINSON, GEORGE F. ..... N89-14278
AUSTIN, AVIS ..... N89-14751
AUSTIN, J. ..... N89-14559
N89-14587
AVDEYEV, A. V. ..... N89-15061
AVEDISSIAN, HAGOP A. ..... N89-14702


## B


BACA, THOMAS J. ..... N89-14460
BACON, D. R. ..... N89-14819
BADAVI, F. F. ..... N89-14821
BADAWY, A. ..... N89-14712
BADO, P. ..... N89-14434
BAEDE, A. P. M. ..... N89-14649
BAGGETT, WAYNE EDWARD ..... N89-15051
BAHILL, A. TERRY ..... N89-14755
BAILEY, J. E. ..... N89-14862
BAKANSKAYA, V. V. ..... N89-14663
BAKER, WAYMAN E. ..... N89-14651
BAKKER, BERT ..... N89-14993
BALAKRISHNAN, A. V. ..... N89-14726
N89-14795
BALL, JOHN F. ..... N89-14670
BALLAL, D. R. ..... N89-14281
BALLHAUS, WILLIAM F., JR. ..... N89-14995
BALZER, R. ..... N89-14711
BANERJEE, P. K. ..... N89-14311
BANSAL, RAKESH K. ..... N89-14716
BARBER, T. ..... N89-14221
N89-14222
BARD, W. D. ..... N89-14858
BARMATZ, MARTIN B. ..... N89-14422
BARNARD-BROWN, E. H. ..... N89-14236
BARNETT, MARK ..... N89-14238
BARRETT, CHARLES A. ..... N89-14303
BARRETT, J. ..... N89-14548
N89-14549
BARRY, R. G. ..... N89-14708
BARSOUM, M. ..... N89-14257
BARTHELENGHI, GEORGE H. ..... N89-14769
BASSARI, JINOUS ..... N89-14977
BATES, GARY T. ..... N89-14640
BATHKE, CHARLES G. ..... N89-14860
N89-14861
BAUER, R. ..... N89-14573
BAYSAL, OKTAY ..... N89-14401
BEACH, TIM A. ..... N89-14238
BEATTY, R. ..... N89-14831
BEAZLEY, WILLIAM G. ..... N89-14756
BECHER, P. F. ..... N89-14260
BECKER, BRIAN R. ..... N89-14400
BECKLEY, DON A. ..... N89-14306
BEERMAN, HENRY ..... N89-14406
BEHYMER, E. M. ..... N89-14877
BELJAARS, ANTON C. M. ..... N89-14631
N89-14646
BELL, R. G. ..... N89-14459
BELOUSKA, YU. I. ..... N89-15061
BENEDICT, TERRY J. ..... N89-14398
BERMUDES, V. M. ..... N89-14280
BERNARDI, CHRISTINE ..... N89-14799
BERRY, G. C. ..... N89-14318
N89-14326
BESHTOEV, KH. M. ..... N89-15069
BHANDARI, P. ..... N89-14831
BHARTIA, P. K. ..... N89-14510
BICKEL, WILLIAM N. ..... N89-14243
BIEG, K. W. ..... N89-14862
BIEL, J. ..... N89-14733
BILHORN, R. B. ..... N89-14287
BIRCH, K. P. ..... N89-14629
BIRCHALL, A. ..... N89-14671
BISHOP, A. R. ..... N89-14394
BLACKER, MICHAEL ..... N89-14225
BLACKMAN, HAROLD S. ..... N89-14935
BLAKE, DONALD R. ..... N89-14606
BLAVIER, J.-F. ..... N89-14546
N89-14550
BLOOM, E. E. ..... N89-14854
BLOOMFIELD, PETER ..... N89-14572
BLUE, JAMES W. ..... N89-14310
BOER, L. C. ..... N89-14230
BOER, LEENDERT ..... N89-14493
BOJKOV, RUMEN ..... N89-14572
BONCH-OSMOLOVSKIJ, A. G. ..... N89-14893
BOTMAN, A. M. ..... N89-14938
BOURCIER, R. J. ..... N89-14296
BOURLAND, CHARLES T. ..... N89-14693
BOUVART, D. ..... N89-14336
BOVILLE, B. A. ..... N89-14589
BOWEN, STUART W. ..... N89-14560
N89-14562
BOWYER, KEVIN ..... N89-14720
BOYER, KEITH ..... N89-14435
BOYLE, M. E. ..... N89-14319
BOYNTON, W. V. ..... N89-15042
N89-15043
N89-15044
N89-15045
BRESSETTE, W. E. ..... N89-14515
BREWER, W. V. ..... N89-14898
BRIEGLEB, B. P. ..... N89-14589
BRINSON, H. F. ..... N89-14307
BROCKETT, ROGER W. ..... N89-14448
BRODY, H. D. ..... N89-14712
BRON, JAN ..... N89-14729
BRONOWSKI, D. R. ..... N89-14412
BROOKS, DAVID R. ..... N89-14634
BROONER, WILLIAM G. ..... N89-14480
BROTHERS, GEORGE ..... N89-14518
BROWELL, EDWARD V. ..... N89-14525
N89-14528
N89-14532
BROWN, JAMES L. ..... N89-14384
BROWN, SAMUEL H. ..... N89-14841
BROWNE, MICHAEL P. ..... N89-14836
BRUEL, ERIK ..... N89-14486
BRUHL, C. ..... N89-14605
BRUINSMA, A. J. A. ..... N89-14454
BRUMLEY, STEPHEN A. ..... N89-14320
BRUNE, W. H. ..... N89-14554
N89-14575
N89-14583
BUI, T. PAUL ..... N89-14560
N89-14562
BURD, W. C. ..... N89-14709
BURKE, G. J. ..... N89-15012
BURKHOLDER, JAMES B. ..... N89-14601
BURSTADT, PAUL L. ..... N89-14386
BUSTIN, ROBERTA ..... N89-14847
BUTLER, C. M. ..... N89-14370
BUTLER, CAROLYN F. ..... N89-14525
BUTRYM, KENNETH P. ..... N89-14702
BYCHUK, O. V. ..... N89-15061
BYRD, GREGORY P. ..... N89-14899


## C


CABRERA, E. ..... N89-14254
CALLISTER, ROBIN ..... N89-14668
CAMERON, EUGENE N. ..... N89-14850
CAMP, J. ..... N89-14892
CAMPANELLA, S. J. ..... N89-14369
CAMPOS, V. ..... N89-14294
CANTONE, RICHARD R. ..... N89-14757
CANUTO, CLAUDIO ..... N89-14799
CAPOBIANCO, T. E. ..... N89-14869
CAPPUCCIO, JOSEPH C., JR. ..... N89-14441
CARDOSO, J. E. B. ..... N89-14458
CARIDE, A. O. ..... N89-14812
CARLIN, D. B. ..... N89-14426
CARLSON, JOSEPH A. ..... N89-14802
CAROFF, LAWRENCE J. ..... N89-14825
CARPENTER, J. R. ..... N89-14514
N89-14524
CARRIGAN, BRIAN JOHN ..... N89-15065
CARROLL, M. A. ..... N89-14543
N89-14553
CARROLL, M. W. ..... N89-14301
CARROLL, R. J. ..... N89-14805
N89-14807
CARROLL, RAYMOND J. ..... N89-14804
CARSON, JEFFREY L. ..... N89-14645
CATON, RANDALL ..... N89-14900
CELESTINA, MARK L. ..... N89-14238
CHAMIS, C. C. ..... N89-14465
CHAN, CHUNG K. ..... N89-14351
CHAN, K. C. D. ..... N89-14355
N89-14356
CHAN, K. ROLAND ..... N89-14520
N89-14531
N89-14554
N89-14555

N89-14557
N89-14560
N89-14562
N89-14565
N89-14566
CHANG, A. ..... N89-14359
CHANG, P. ..... N89-14827
CHAPMAN, GILES NICHOLAS FENGER ..... N89-15050
CHAU, H. H. ..... N89-14410
CHAUDHARI, P. ..... N89-14873
CHAYKOVSKY, M. ..... N89-14325
CHELLAPPA, R. ..... N89-14723
CHEN, C. ..... N89-14515
CHEN, T. H. ..... N89-14281
CHEN, TSING-CHANG ..... N89-14651
CHERNOV, N. I. ..... N89-14803
CHIPPERFIELD, M. P. ..... N89-14603
CHITRE, D. M. ..... N89-14369
CHOU, CHAUR-MING ..... N89-14001
CHOW, E. ..... N89-14831
CHOY, F. C. ..... N89-14452
CHRISTMAS, P. ..... N89-14828
CHRISTOPHOROU, L. G. ..... N89-14383
CHUBACHI, SHIGERU ..... N89-14504
CHUBB, DONALD L. ..... N89-14348
CHUM, FRANK Y. ..... N89-14948
N89-14956
N89-14962
N89-14978
N89-14980
CICHRA, D. A. ..... N89-14325
CINLAR, ERHAN ..... N89-14814
CINTALA, MARK J. ..... N89-14999
N89-15008
N89-15009
CLARK, A. F. ..... N89-14869
CLARK, B. F. ..... N89-14437
CLEMMONS, JAMES I., JR. ..... N89-14385
CLIFFORD, STEPHEN M. ..... N89-15059
CLOUGHLEY, WILLIAM R. ..... N89-14736
CODY, W. J. ..... N89-14700
COFFEY, M. T. ..... N89-14545
N89-14551
COLIN, A. M. ..... N89-15052
COLLINS, L. A. ..... N89-14780
COLLINS, MAURICE W. ..... N89-14698
COLOMBI, JOHN M. ..... N89-14362
COLSON, STEVEN D. ..... N89-14285
COMPOSTIZO, C. ..... N89-14254
CONLEY, W. R. ..... N89-14876
CONNOLLY, EDWARD M. ..... N89-14364
CONNOLLY, J. C. ..... N89-14426
CONROYD, JACK H., JR. ..... N89-14397
CONRY, SUSAN E. ..... N89-14774
CONSTERDINE, I. E. ..... N89-14643
COOK, A. ..... N89-14733
COOK, D. L. ..... N89-14862
COOPER, JAMES A., JR. ..... N89-14380
COOPER, R. K. ..... N89-14356
COPLAN, MICHAEL A. ..... N89-15063
CORDEIRO, NORBERT R. ..... N89-14644
COREY, J. D. ..... N89-14997
CORKE, THOMAS ..... N89-14242
CORLISS, JOHN M. ..... N89-14444
CORMAN, D. ..... N89-14336
CORRIGAN, MARTIN ..... N89-14651
CORSO, GEORGE J. ..... N89-15001
N89-15003
N89-15010
COURSEY, J. ..... N89-14707
COUVILLION, W. ..... N89-14248
N89-14354
COX, JAMES A. ..... N89-14808
COX, PRESTON A. ..... N89-14758
COX, R. A. ..... N89-14600
COY, J. J. ..... N89-14453
COYLE, T. W. ..... N89-14257
COZZENS, R. F. ..... N89-14319
CRABB, THOMAS M. ..... N89-14852
CRABTREE, G. W. ..... N89-14872
CRANMER, D. C. ..... N89-14257
CRAVEN, J. ..... N89-14515
CRISP, D. ..... N89-14595
CROSS, JEFFREY L. ..... N89-14216
CROSS, P. ..... N89-14828
CROW, J. T. ..... N89-14862
CRUTZEN, P. J. ..... N89-14605
CU, C. C. ..... N89-14648
CURTIS, HENRY B. ..... N89-14310
CUTLER, RAYMOND A. ..... N89-14463
CUTTS, DAVID ..... N89-14732
CZYSZCZEWSKI, MARY ..... N89-14721

## D

DANDEKAR, DATTATRAYA P. ..... N89-14299
DANIEL, STEVEN P. ..... N89-14248
N89-14354
DANIELSEN, E. F. ..... N89-14575
DANSHIN, S. N. ..... N89-15061
DARGUSH, G. F. ..... N89-14311
DASGUPTA, GAUTAM ..... N89-14776
DATSKOV, V. I. ..... N89-14413
DAUPHIN, J. ..... N89-14244
DAVIDIAN, M. ..... N89-14805
DAVIDOVITS, PAUL ..... N89-14538
DAVIDSON, C. A. ..... N89-14942
DAVIE, N. T. ..... N89-14459
DAVISON, J. W. ..... N89-14744
DAY, JON ..... N89-14560
DEAN, STEPHEN O. ..... N89-14851
DEBRIUM, J. P. ..... N89-14997
DEGOEY, LAURENTIUS PHILIPPUS HENDRIKA
N89-14829
DEGROH, HENRY C., III ..... N89-14341
DEHAAS, VINCENT ..... N89-14494
DEHOFF, R. T. ..... N89-14293
DEININGER, W. ..... N89-14831
DEITZ, PAUL H. ..... N89-14710
DEJONG, HANS ..... N89-14728
DEKLEER, JOHAN ..... N89-14743
DEKOSTER, E. ..... N89-14730
DELAUNE, CARL I. ..... N89-14770
DELEEUW, G. ..... N89-14630
DEMORE, W. B. ..... N89-14602
DENCH, W. A. ..... N89-14724
DENTON, M. B. ..... N89-14287
N89-14288
N89-14382
N89-14863
DENTREMONT, ROBERT P. ..... N89-14414
DEPOY, DARREN LEE ..... N89-15053
DEPPE, J. ..... N89-14733
DERUITER, TARS ..... N89-14729
DESHMUKH, U. V. ..... N89-14257
DESJARLAIS, M. P. ..... N89-14862
DEUTSCH, MORRIS ..... N89-14480
DEVINCENZI, DONALD ..... N89-15003
DEVINCENZI, DONALD L. ..... N89-15017
DEW, D. A. ..... N89-14437
DEWALT, DIANE V. ..... N89-14902
DEWAS, J. N. ..... N89-14335
DEYMIER, P. ..... N89-14294
DEZAFRA, R. L. ..... N89-14548
N89-14549
DIBARTOLO, B. ..... N89-14903
DICKEN, WILLIAM A. ..... N89-14722
DICKERSON, GEORGE E. ..... N89-14258
DIDWALL, E. M. ..... N89-15012
DIFILIPPO, FRANK ..... N89-14416
DILLARD, D. A. ..... N89-14307
DILLON, M. M. ..... N89-14437
DIPADUA, M. A. ..... N89-14226
DITCHEK, B. ..... N89-14884
DITTERS, BERT E. J. ..... N89-14777
DIXON, SIDNEY C. ..... N89-14264
DOBSON, M. C. ..... N89-14621
DOIRON, SCOTT D. ..... N89-14505
DOMINICK, WAYNE D. ..... N89-14947
N89-14948
N89-14949
N89-14950
N89-14951
N89-14952
N89-14953
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N89-14986
N89-14987
N89-14988
N89-14989
N89-14990
N89-14991
N89-14992
DONALDSON, LEON M. ..... N89-14904
DONNELLAN, ANDREA ..... N89-14624
DORAN, D. G. ..... N89-14854
DORIA, MICHAEL L. ..... N89-14905
DOW, T. A. ..... N89-14447
DOWNS, M. J. ..... N89-14629
DOYCHAK, JOSEPH ..... N89-14297
DRAKE ..... N89-15042
N89-15043
N89-15044
N89-15045
DRAPER, PETER WALTER ..... N89-15054
DRESS, DAVID A. ..... N89-14241
DRITSCHEL, D. G. ..... N89-14593
DRUMMOND, T. J. ..... N89-14879
DUBA, AL ..... N89-15002
N89-15003
N89-15011
N89-15012
DUDLEY, GARY A. ..... N89-14668
DUIJN, JOZEF HENRICUS ..... N89-14419
DUNCAN, PHILLIP C. ..... N89-14775
DUNN, B. D. ..... N89-14244
DUNN, M. H. ..... N89-14820
DVORAK, GEORGE J. ..... N89-14262
DYER, FREDERICK N. ..... N89-14669
DYER, M. I. ..... N89-14637
DYER, P. ..... N89-14892

## E

EBERT, ELIZABETH EBY ..... N89-14635
EDEL, M. ..... N89-14733
EGGERT, DAVID ..... N89-14720
EILEK, JEAN A. ..... N89-14825
EKIN, J. W. ..... N89-14869
EL-BAYOUMY, L. E. ..... N89-14452
ELDERHORST, MARLEEN M. M. ..... N89-14488
ELLIOTT, ANDREW SETH ..... N89-14240
ELLIOTT, GLENN R. ..... N89-14368
ELLIOTT, RICHARD A. ..... N89-14837
EMBRECHTS, MARK ..... N89-14844
EMERY, JAMES W., JR. ..... N89-14263
EMMONS, L. ..... N89-14548
N89-14549
ENGELMANN, BRUCE E. ..... N89-14461
N89-14462
ENGLERT, THAD J. ..... N89-14817
ENGLISH, ROBERT E. ..... N89-14853
EOYANG, CHRISTOPHER ..... N89-14697
EPPERSON, P. M. ..... N89-14288
EROSHKINA, L. A. ..... N89-15061
ERRICO, RONALD M. ..... N89-14640
ESCHBACH, P. A. ..... N89-14275
ESCOBAR, J. ..... N89-14254
ESTES, JOHN E. ..... N89-14481
ESTLER, W. TYLER ..... N89-14405
ETHERIDGE, Y. H. ..... N89-14785
ETTENBERG, M. ..... N89-14426
EUBANK, C. S. ..... N89-14555
EVANS, CHRIS ..... N89-14445
EVANS, D. S. ..... N89-14619
EVANS, H. ..... N89-14294
EVANS, W. F. J. ..... N89-14578
N89-14579
EWELL, R. ..... N89-14831
EXARHOS, G. J. ..... N89-14314

## F

FAETH, G. M. ..... N89-14396
FAHEY, D. W. ..... N89-14531
N89-14532
N89-14555
N89-14564
N89-14565
FAHEY, F. ..... N89-14712
FAIRALL, C. W. ..... N89-14626
FAIZOV, E. L. ..... N89-15061

FALLON, KRISTINE N89-14721
FANALE, FRASER N89-15035
FANTI, ANDREW J. N89-14408
FARMER, C. B. N89-14546
N89-14550
FARMER, CROFTON B. N89-14528
FAROOQ, MOHAMMAD U. N89-14972
FAST, H. N89-14578
FAZIO, M. V. N89-14830
FEBER, H. J. N89-14753
FELCHER, G. P. N89-14873
FELDMAN, YISHAI A. N89-14715
FELIPPA, CARLOS A. N89-14472
N89-14473
FENN, MARTA A. N89-14634
FERGUSON, JAY C. N89-14759
FERISS, D. H. N89-14301
FERREIRA, NELSON JESUS N89-14620
FERRY, G. V. N89-14522
N89-14527
N89-14531
N89-14532
N89-14541
N89-14555
N89-14564
FERTIS, D. G. N89-14465
FICKES, G. N. N89-14312
FIFER, ROBERT A. N89-14339
N89-14773
FILGUEIRASDEAZEVEDO, JOAO LUIZ N89-14215
FILLENBAUM, SAMUEL N89-14808
FINGER, JOERG E. N89-14633
FINK, PAMELA K. N89-14747
FISCHLER, M. N89-14733
FISHER, M. N89-14314
FLATHER, R. A. N89-14652
FLECK, JOHN T. N89-14685
N89-14688
FLECK, STEVEN J. N89-14668
FLEISCHMAN, JOYCE D. N89-14682
FOHEY, MICHAEL F. N89-14693
FONG, W. N89-14527
FONTANA, J. R. N89-14433
FORRAI, D. P. N89-14725
FORRESTER, MARTIN GERARD N89-14867
FOWLER, JOHN D., JR. N89-14703
FRANCHOIS, P. R. N89-14519
FRANCIS, H. D. N89-14833
FRANK, ALAN M. N89-14411
FRANK, JONATHAN N89-14406
FRANKEL, JULIUS N89-14340
FREEMAN, JOHN W. N89-15003
N89-15013
N89-15024
FREIMAN, S. W. N89-14257
FREISER, BEN S. N89-14431
FREY, ROBERT J. N89-14745
FRIEDL, RANDALL R. N89-14599
FRIEDL, RANDY N89-14607
FRISH, MICHAEL N89-14406
FROST, C. A. N89-14437
FRYDRYCH, W. S. N89-14314
FUJITA, T. N89-14831
FUJIWARA, M. N89-14592
FULLER, E. R., JR. N89-14257
FULTON, JAMES P. N89-14906


## G


GAIER, JAMES R. N89-14310
GAINES, I. N89-14733
GALANTE, LEONARD J. N89-14273
GALIMORE, REGINALD N89-14505
GALLAGHER, MARY C. N89-14960
N89-14961
GALLAGHER, SUZY N89-14955
N89-14962
GANAPOL, BARRY D. N89-14907
GANN, V. V. N89-14295
GAO, BO CAI N89-14622
GARCIA, MARIA M. N89-14586
GARDNER, THOMAS R. N89-14685
N89-14688
GARNER-GILCHRIST, CATHINE N89-14908
GAROFALINI, S. H. N89-14314
GARRETT, W. R. N89-14429
GARWOOD, ROBERT WALTER N89-15055
GARY, BRUCE L. N89-14558
GASPAR, MARK S. N89-14422
GATEWOOD, JOHN R. N89-14351
GATLIN, GREGORY M. N89-14213
GAUGER, JAMES R. N89-14360
GAULT, D. E. N89-15033
N89-15034
GAVERN, J. N89-14226
GAVRIN, V. N. N89-15061
GAWRON, VALERIE J. N89-14670
GAYNOR, MICHAEL W. N89-14757
GEAR, C. W. N89-14783
GEE, J. M. N89-14499
N89-14501
GEISELHART, R. N89-14226
GELLER, MARVIN A. N89-14591
GELMAN, MELVYN E. N89-14511
GENTILE, F. T. N89-14321
GEORGE, PAUL E. N89-14444
GEORGE, THOMAS F. N89-14894
GERARD, D. A. N89-14464
GERBER, R. A. N89-14862
GERSH, MARK A. N89-14748
GERY, M. W. N89-14609
GEURTSEN, F. W. M. N89-14945
GIBBONS, RANDALL E. N89-14691
GIBSON, EVERETT K., JR. N89-14847
GIBSON, R. B. N89-14430
GIERSZEWSKI, PAUL N89-14844
GILBERT, JOHN A. N89-14417
GILBERT, M. C. N89-15014
GILLETTE, D. A. N89-15015
GILLETTE, DALE N89-15000
GIULLIANI, JOHN L., JR. N89-14438
GLANTZ, C. S. N89-14641
GLASS, A. S. N89-14280
GLASSER, A. H. N89-14855
GLASSMAN, ARTHUR J. N89-14237
GLENN, LEWIS A. N89-14246
GLOERSEN, P. N89-14648
GOAD, H. S. N89-15007
GOGINENI, S. P. N89-14479
GOLDEN, DAVID M. N89-14537
GOLDMAN, AARON N89-14547
N89-14601
GOLDSTEIN, B. N89-14426
GOLDSTEIN, S. A. N89-14862
GOLDSWORTHY, MICHAEL PHILIP N89-14840
GOLDWASSER, J. M. N89-14325
GONCHAROV, I. N. N89-14878
GONZALEZ, C. C. N89-14379
GOODALL, COLIN N89-14809
GOODMAN, J. K. N89-14527
N89-14530
GOODRICH, L. F. N89-14869
GOSNELL, T. R. N89-14430
GOUTAIL, F. N89-14577
GOUVEA, M. E. N89-14394
GRAESSLE, S. N89-14892
GRANDRUD, B. W. N89-14526
GRANIER, MARTIN N89-14952
N89-14955
N89-14962
N89-14986
GRASS, R. D. N89-14519
GRATZER, LOUIS B. N89-14909
GRAY, L. J. N89-14596
GREELEY, RONALD N89-14998
N89-15000
N89-15020
N89-15021
N89-15022
N89-15026
N89-15027
N89-15039
N89-15059
GREEN, C. N89-14707
GREEN, M. C. N89-14432
GREEN, S. M. N89-14874
GREEN, TERRY J. N89-14910
GREENBAUM, ELIAS N89-14667
GREENFIELD, C. M. N89-14858
GREENSTEIN, J. S. N89-14719
GREER, JERRY D. N89-14482
GRELL, GEORG A. N89-14639
GRIEVE, RICHARD A. F. N89-15016
GRIFFEN, J. W. N89-14275
GRIFFITHS, LYNN D. N89-15001
N89-15017
GRINSTEIN, F. F. N89-14399
GROSCH, C. E. N89-14402
GROSSMAN, M. N89-14831
GROVE, T. L. N89-15018
N89-15019
GRUBB, DAVID P. N89-14943
GUBAG, KEVIN MALUPEN N89-14268
GUBKIN, E. N89-14828
GUSTAFSON, J. N89-14884
GUTH, R. E. N89-14744
GUTHREAU, W. H. N89-14877
GUYENNE, T. D. N89-14937
GUZONAS, DAVID A. N89-14278
GYEBI, OSEI K. N89-14776
GYEKENYESI, JOHN P. N89-14470


## H


HABERLE, ROBERT M. N89-15059
HADDOCK, D. J. N89-15056
HADLEY, BRENT L. N89-14749
HAENEL, GOTTFRIED N89-14625
HAERDLE, WOLFGANG N85-14804
HAFELE, JOSEPH C. N89-14911
HAFF, P. K. N89-15038
HAGANS, K. G. N89-14833
HAGER, BRADFORD H. N89-14624
HAIGH, R. E. N89-14833
HAILEY, C. J. N89-15068
HAJASH, A. N89-15014
HALICIOGLU, TIMUR N89-14824
HALL, MICHAEL N89-14352
HALL, PETER N89-14807
HALL, PHILIP P. N89-14956
N89-14962
N89-14963
N89-14964
N89-14980
N89-14981
N89-14986
N89-14987
N89-14988
N89-14989
HALLER, W. N89-14257
HALLORAN, JOHN W. N89-14888
HAMANN, FREDERICK WILLIAM, III N89-15066
HAMBOURGER, PAUL D. N89-14310
HAMIL, R. A. N89-14862
HAMILTON, P. L. N89-14616
HAMMEL, J. E. N89-14855
HAMMER, PHILIP D. N89-14601
HAMMONS, KVIN R. N89-14683
HAMPEL, VIKTOR E. N89-14943
HAN, D. N89-14648
HANCE, R. N89-14733
HANDEL, PETER H. N89-14381
HANING, ROBERT K. N89-14243
HANNAH, PHIL N89-14445
HANSEN, B. R. N89-14499
HANSEN, MARION GLENN N89-14912
HANSON, DAVID N89-14533
HAQUE, AZIZUL N89-14894
HARADEM, DAVID P. N89-14360
HARDER, J. W. N89-14512
N89-14514
N89-14523
N89-14524
HARDING, JOHN M., JR. N89-14654
HARELAND, W. A. N89-14292
HARPER, S. E. N89-14430
HARRIS, FRANK W. N89-14337
HARRIS, MICHAEL N89-14818
HARRIS, MICHAEL E. N89-14760
HARRIS, NEIL N89-14572
HARRISON, DEAN R. N89-14384
HARRISON, F. N89-15068
HARTE, C. G. N89-14349
HARTER, D. N89-14434
HARTMAN, SVEN R. N89-14282
HARTMANN, D. N89-14567
HASLUND, C. A. N89-14277
HAVENS, STEPHEN J. N89-14337
HAYES, BARBARA C. N89-14672
HAYLING, KJELL LENNART N89-14653
HAYMAN, G. D. N89-14600
HAYNES, P. H. N89-14594
HAZELL, L. B. N89-14724
HEATH, DONALD F. N89-14513
HEIDT, L. E. N89-14561
N89-14564
N89-14567
HEIDT, LEROY E. N89-14556
HELGASON, RICHARD V. N89-14362
HEMANN, JOHN H. N89-14470
HENNING, HARALD MARTIN JAKOB N89-15060
HENRY, BRUCE E. N89-14556
N89-14561
HENRY, D. P. N89-14311
HEPP, ALOYSIUS F. N89-14310
HERBER, R. N89-14656
HEREFORD, J. N89-14514
HERGENROTHER, PAUL M. N89-14337
HERNANDEZ, G. N89-14627
HEYDORN, RICHARD P. N89-15004
HIEFTJE, GARY M. N89-14272
N89-14273
HIGGINS, ALAN N89-14358
HILDEBRAND N89-15042
N89-15043
N89-15044
N89-15045

HILL, V. J. ..... N89-14619
HILLEKE, R. O. ..... N89-14873
HILLMAN, DANIEL C. ..... N89-14270
HINTZ, JOSEPH C. ..... N89-14761
HJALMARSON, H. P. ..... N89-14879
HO, JAMES C. ..... N89-14299
HOCHULI, U. ..... N89-14427
HOEBERLING, R. F. ..... N89-14830
HOERZ, F. ..... N89-15008
HOERZ, FRIEDRICH ..... N89-14999
HOFFMAN, D. MARK ..... N89-14316
HOFFMAN, JOHN S. ..... N89-14610
N89-14611
N89-14612
HOFMAN, C. ..... N89-14647
HOFMANN, D. J. ..... N89-14512
N89-14514
N89-14523
N89-14524
HOFTUN, JAN S. ..... N89-14732
HOGO, H. ..... N89-14609
HOGSETT, WILLIAM E. ..... N89-14608
HOLDREN, M. W. ..... N89-14617
HOLMAN, G. T. ..... N89-14862
HOLMES, HARLAN K. ..... N89-14408
HOLMES, J. T. ..... N89-14277
HOLNOVA, E. ..... N89-14828
HOLT, PHOEBE E. ..... N89-14679
HOLT, R. J. ..... N89-14432
HOLT, WILLIAM H. ..... N89-14303
HOLZSCHEITER, M. H. ..... N89-14892
HOPKINS, MARK ALAN ..... N89-14387
HORIE, NORITOSHI ..... N89-14870
HOSKINS, E. ..... N89-15014
HOVING, SIMEN J. ..... N89-14777
HOVIS, WAYNE W. ..... N89-14883
HOWARD, CARLETON J. ..... N89-14601
HOWELLS, M. R. ..... N89-14409
HREN, J. J. ..... N89-14293
HUAN, CHENG HON ALFRED ..... N89-14816
HUBBERT, K. P. ..... N89-14652
HUEBNER, STEVEN ROY ..... N89-14389
HUFF, DENNIS L. ..... N89-14220
HUGHES, D. P. ..... N89-14617
HULST, R. V. D. ..... N89-14365
HUNG, CHING-CHEH ..... N89-14259
HUNT, JAMES ..... N89-14937
HUNT, RUSTON M. ..... N89-14775
HUNTER, S. R. ..... N89-14383
HUSSAIN, F. ..... N89-14399
HUSTON, RONALD L. ..... N89-14450
HUTCHINS, EDWIN L., JR. ..... N89-14690
HWANG, W. S. ..... N89-14712
HYMAN, ELLIS ..... N89-14438


## I


IHEBUZOR, VALENTINE U. ..... N89-14959
INGELS, FRANK M. ..... N89-14248
N89-14354
IRISH, DONALD E. ..... N89-14278
ISAAC, KAKKATTUKUZHY ..... N89-14913
ISLAM, M. M. ..... N89-14641
ISMAIL, SYED ..... N89-14525
IVERSEN, JAMES D. ..... N89-15000
N89-15020
N89-15021
N89-15022
N89-15039
IWASAKA, Y. ..... N89-14570


## J


JACKSON, DANIEL ..... N89-14714
JACKSON, T. L. ..... N89-14402
JACOBS, MARK K. ..... N89-14852
JACOBSEN, C. ..... N89-14409
JAFFE, L. ..... N89-14831
JAKOUBEK, R. O. ..... N89-14544
N89-14576
JALKIAN, R. D. ..... N89-14288
JAMES, A. C. ..... N89-14671
JAMIESON, JOHN R. ..... N89-14770
JANSSEN, G. J. M. ..... N89-14365
JARAMILLO, M. ..... N89-14548
N89-14549
JAYNE, JOHN ..... N89-14538
JENSEN, J. H. ..... N89-14827
JHUN, JONG-GHAP ..... N89-14618
JIANG, C. ..... N89-14874
JOENSSON, LARS ..... N89-14353
JOHNS, ALBERT L. ..... N89-14386
JOHNSON, A. ..... N89-14421
JOHNSON, ALAN M. ..... N89-14227
JOHNSON, MARJORY J. ..... N89-14695
JOHNSON, R. R. ..... N89-14447
JOHNSON, WILLIAM B. ..... N89-14775
JOHNSON, WILLIAM G., JR. ..... N89-14241
JOHNSTON, DONALD E. ..... N89-14228
JOHNSTON, P. V. ..... N89-14542
JOJOLA, J. M. ..... N89-14437
JONES ..... N89-15042
N89-15043
N89-15044
N89-15045
JONES, D. TODD ..... N89-14686
JONES, DAVID F. ..... N89-14699
JONES, G. J. ..... N89-14498
JONES, PAUL R. ..... N89-14328
JONES, R. L. ..... N89-14532
N89-14559
N89-14564
N89-14587
JONES, ROD ..... N89-14525
JORDAN, JOSEPH ..... N89-14536
JOSEPHSON, PAUL R. ..... N89-14839
JUDD, M. D. ..... N89-14244


## K


KAFIZOVA, R. M. ..... N89-14661
KAHN, S. M. ..... N89-15068
KAJIWARA, RYOICHI ..... N89-14504
KALEPS, INTS ..... N89-14685
N89-14688
KANETKAR, SHARAD V. ..... N89-14385
KAPASOURIS, PETROS ..... N89-14377
KAR, A. ..... N89-14415
KATER, STANLEY B. ..... N89-14672
KAUFMAN, LLOYD ..... N89-14681
KAVI, SRINU ..... N89-14953
N89-14957
N89-14958
N89-14967
N89-14985
KEATING, G. M. ..... N89-14515
KELLY, K. K. ..... N89-14520
N89-14531
N89-14532
N89-14564
N89-14565
N89-14566
KEMMERLY, GUY T. ..... N89-14217
KENNINGTON, JEFFREY L. ..... N89-14362
KENSELAAR, FRANK ..... N89-14487
KEPHART, ELISA M. ..... N89-14941
KERR, J. B. ..... N89-14578
N89-14579
KESTER, DANA A. ..... N89-14655
KEY, J. R. ..... N89-14708
KEYS, J. G. ..... N89-14542
N89-14547
KIA, T. ..... N89-14831
KIEFER, RICHARD L. ..... N89-14914
KIEHL, J. T. ..... N89-14589
KILMER, NEAL ..... N89-14625
KIM, G. ..... N89-14326
KIM, S. T. ..... N89-14648
KING, D. L. ..... N89-14499
KING, ROGER ..... N89-14944
KINNE, STEFAN ..... N89-14528
KINROSS-WRIGHT, J. ..... N89-14830
KIRCHNER, TED E. ..... N89-14466
KIRKHAM, H. ..... N89-14421
KIRSCHENBAUM, AUDREY ..... N89-14684
KIRZ, J. ..... N89-14409
KITTUR, MADAN G. ..... N89-14450
KJOME, N. T. ..... N89-14512
KLEESPIES, THOMAS J. ..... N89-14414
KLEIN, E. ..... N89-14573
KLEINSTREUER, C. ..... N89-14393
KLIJNJAN, A. J. ..... N89-14229
KLIMCHUK, JAMES A. ..... N89-15062
KLUZNIAK, WLODZIMIERZ ..... N89-15057
KNIP, GERALD, JR. ..... N89-14237
KNOPF-LENOIR, C. ..... N89-14451
KO, MALCOLM K. W. ..... N89-14555
N89-14569
N89-14585
KOCZAK, M. J. ..... N89-14257
KOEPKE, B. G. ..... N89-14327
KOHL, WILFRID L. ..... N89-14839
KOHN, W. ..... N89-14827
KOK, A. J. ..... N89-14938
KOKER, EDMOND B. ..... N89-14915
KOKTA, MILAN R. ..... N89-14883
KOLB, CHARLES ..... N89-14538
KOMHYR, W. D. ..... N89-14519
KONDIC, NENAD N. ..... N89-14916
KONDOH, KOUJI ..... N89-14504
KONG, FUNG-MING ..... N89-14317
KONRAD, M. ..... N89-14711
KOOI, SUSAN A. ..... N89-14525
KORDIC, SRDJAN ..... N89-14890
KOSS, D. A. ..... N89-14464
KOSTERS, ANTON J. M. ..... N89-14485
KOWALCZYK, R. S. ..... N89-14432
KRACIUN, K. N. ..... N89-14866
KRAEMER, WILLIAM J. ..... N89-14668
KRAFT, DIETER ..... N89-14731
KRAKOWSKI, ROBERT A. ..... N89-14860
N89-14861
KRATZER, R. H. ..... N89-14309
KRIENS, RUDOLF FRANCOIS CORNELIS ..... N89-14420
KRUEGER, ARLIN J. ..... N89-14505
N89-14510
N89-14525
N89-14571
KUAN, JULIE C. ..... N89-14990
KUBINEC, WILLIAM R. ..... N89-15031
KUESTER, S. E. ..... N89-14519
KUHN, BOB ..... N89-14746
KULCINSKI, G. L. ..... N89-14843
KULESSA, G. ..... N89-14573
KUNG, YAO ..... N89-14726
KURBATOV, V. S. ..... N89-14803
KURZIUS, S. C. ..... N89-14704
KUZNETSOV, A. N. ..... N89-14701
KWOK, W. K. ..... N89-14872


## L


LAHAYE, R. J. ..... N89-14858
LAIBOWITZ, R. B. ..... N89-14873
LAIT, LESLIE R. ..... N89-14516
N89-14568
N89-14584
LANDER, W. BRENT ..... N89-14757
LANG, VALERIE ..... N89-14607
LANGENOUGH, M. A. ..... N89-14250
LANKFORD, JAMES ..... N89-14324
LARSEN, J. C. ..... N89-14508
LARSEN, SHAWN ..... N89-14624
LARSEN, SOREN H. H. ..... N89-14580
LASSER, DIETER ..... N89-14791
LATHAM, J. ..... N89-14643
LAW, CHUNG K. ..... N89-14284
LAW, RACHEL ..... N89-14638
LAWS, NORMAN ..... N89-14262
LAYER, HOWARD P. ..... N89-14405
LEACH, R. N. ..... N89-15021
N89-15022
N89-15039
LEACH, RODMAN ..... N89-15000
LEADBETTER, M. R. ..... N89-14806
LEE, CHU-HWA ..... N89-14455
LEE, E. HENRY ..... N89-14608
LEE, IK-SANG ..... N89-14391
LEE, IN-JA B. ..... N89-14792
LEEBEEK, H. J. ..... N89-14230
LEFEBVRE, DIDIER R. ..... N89-14307
LEI, GUANG-TSAI ..... N89-14479
LEIJA, J. ..... N89-14437
LEIMKUHLER, BENEDICT J. ..... N89-14781
LEKAN, JACK ..... N89-15047
LEONARD, B. P. ..... N89-14794
LESTER, C. S. ..... N89-14430
LEU, MING-TAUN ..... N89-14539
LEVADOU, F. G. ..... N89-14244
LEWICKI, D. G. ..... N89-14453
LEWIS ..... N89-15042
N89-15043
N89-15044
N89-15045
LEWIS, H. R. ..... N89-14855
LEWIS, JOHN G. ..... N89-14717
LIANG, EDISON P. ..... N89-15067
LICHTENSTEIN, SARAH ..... N89-14936
LIEBERT, CURT H. ..... N89-14418
LIEDAHL, D. ..... N89-15068
LIGHTMAN, A. J. ..... N89-14281
LILIENTAL-WEBER, Z. ..... N89-14875
LIM, BEE LEE ..... N89-14989
LIN, SHU ..... N89-14706
LINDEMUTH, I. R. ..... N89-14855
LINK, L. R. ..... N89-14298
LIPETZKY, P. ..... N89-14260
LISAGOR, W. BARRY ..... N89-14264
LITOVCHENKO, V. ..... N89-14871
LITVIN, F. L. ..... N89-14453
LIU, I-HSIUNG ..... N89-14954
N89-14965
N89-14966
LIVINGSTON, J. M. ..... N89-14522

LLOYD, MARY M. ..... N89-14670
LOEWENSTEIN, M. ..... N89-14520
N89-14541
N89-14557
N89-14564
N89-14565
N89-14566
N89-14567
N89-14568
LOFGREN, GARY ..... N89-15023
LONGDON, NORMAN ..... N89-14244
N89-14937
LOONEY, LARRY D. ..... N89-14832
LOOYEN, W. J. ..... N89-14490
LOPEZ, R. E. ..... N89-15024
LOPEZ, RAMON ..... N89-15003
LOTH, E. ..... N89-14396
LOUBRIEL, G. M. ..... N89-14876
LOVBERG, R. H. ..... N89-14855
LOVERING, P. ..... N89-14226
LOWES, L. L. ..... N89-14546
LUBECK, OLAF M. ..... N89-14697
LUBIN, P. M. ..... N89-15068
LUCK, S. ..... N89-14254
LUEB, RICHARD A. ..... N89-14556
N89-14561
LUK, TING SHAN ..... N89-14435
LUND, THOMAS S. ..... N89-14917
LUO, H. L. ..... N89-14874
LUSTH, JOHN C. ..... N89-14747
LYNN, KUNIKO YAMADA ..... N89-14839
LYNN, LEONARD H. ..... N89-14839
LYONS, PETER B. ..... N89-14832

## M

MACKINNON, IAN D. R. ..... N89-15001
N89-15025
MADAY, YVON ..... N89-14799
MAHAN, JOHN E. ..... N89-14881
MAINE, P. ..... N89-14434
MALONE, JACQUELINE C. ..... N89-14683
MANION, STEPHEN J. ..... N89-14885
MANKBADI, REDA R. ..... N89-14403
MANKIN, WILLIAM G. ..... N89-14545
N89-14551
MANSER, G. E. ..... N89-14330
MANSOUR, A. ..... N89-14873
MARCHAND, ALAN P. ..... N89-14323
MARCHENKO, I. G. ..... N89-14295
MARIC, MILENA ..... N89-14266
MARIELLA, R. P. ..... N89-14877
MARRONE, MICHAEL P. ..... N89-14757
MARSHALL, JOHN R. ..... N89-15000
N89-15001
N89-15021
N89-15026
N89-15027
MARTENS, JOHANNES HUBERTUS ANNA ..... N89-14889
MARTIN, E. RAY ..... N89-14699
MARTIN, J. P. D. ..... N89-14822
MARTIN, R. ..... N89-14568
MASER, J. G. ..... N89-14465
MASIULANIEC, KONSTANTY C. ..... N89-14235
MASLANIK, J. A. ..... N89-14708
MASTIN, CHARLES WAYNE ..... N89-14918
MATHIAS, LON J. ..... N89-14322
MATIC, ROY MARK ..... N89-14815
MATSON, B. S. ..... N89-14275
MATSUBARA, HIDEAKI ..... N89-14870
MATTHEWS, FLORIDA M. ..... N89-14316
MATTHEWS, W. A. ..... N89-14547
MAUERSBERGER, KONRAD ..... N89-14533
MAXION, ROY A. ..... N89-14762
MAZEL, DAVID S. ..... N89-14407
MAZUMDER, J. ..... N89-14415
MCCALL, G. H. ..... N89-14855
MCCASKILL, MARY K. ..... N89-14994
MCCORMICK, M. PATRICK ..... N89-14508
N89-14521
N89-14522
N89-14525
N89-14532
MCCOY, JOHN ..... N89-14466
MCCULLEY, MICHAEL ..... N89-14721
MCDERMOTT, GENE ..... N89-14721
MCDONALD, K. C. ..... N89-14621
MCELROY, M. B. ..... N89-14604
MCELROY, WILLIAM D. ..... N89-14283
MCGOWEN, MICHAEL ..... N89-14703
MCHENRY, K. D. ..... N89-14327
MCINTYRE, MICHAEL ..... N89-14588
MCKAY, DAVID S. ..... N89-14847
MCKENNA, D. S. ..... N89-14559
N89-14564
N89-14587
MCKENZIE, B. B. ..... N89-14876
MCKIM, JAMES M. ..... N89-14614
MCLARTY, TYCE T. ..... N89-14698
MCLINDEN, MARK O. ..... N89-14390
MCMILLAN, C. F. ..... N89-14410
MCMILLAN, S. H. ..... N89-14376
MCPETERS, R. D. ..... N89-14509
MCPHERSON, J. A. ..... N89-14319
MCQUAID, K. ..... N89-14409
MCWHORTER, ALAN L. ..... N89-14342
MCWRIGHT, G. M. ..... N89-14877
MEI, Y. ..... N89-14874
MEISSNER, FRANCES T. ..... N89-14475
MENDELEEV, D. I. ..... N89-14828
MENDEZ, RAUL H. ..... N89-14697
MERRITT, EARL S. ..... N89-14480
MERTENS, F. G. ..... N89-14394
METIVET, BRIGITTE ..... N89-14799
MEYER, ROBERT A. ..... N89-14774
MEYER, W. R. ..... N89-14321
MEYERS, JAMES F. ..... N89-14385
MIAMEE, A. G. ..... N89-14800
N89-14810
MICHEL, F. C. ..... N89-15024
MIESS, JOSEPH ..... N89-14225
MILES, R. N. ..... N89-14919
MILEY, GEORGE H. ..... N89-14845
MILLER, ALVIN J. ..... N89-14597
MILLER, JAMES C. ..... N89-14670
MILLER, R. D. ..... N89-14312
N89-14313
MILLER, ROBERT E., II ..... N89-14680
MILLER, S. ..... N89-14712
MILLER, S. E. ..... N89-14617
MIMPEN, A. M. ..... N89-14230
N89-14373
MINNETT, P. J. ..... N89-14484
MIRTICH, MICHAEL J. ..... N89-14416
MISHONOV, T. M. ..... N89-14790
MITTRA, R. ..... N89-14359
MIU, L. ..... N89-14878
MOEHLER, O. ..... N89-14574
MOHLER, G. ..... N89-14550
MOLINA, MARIO J. ..... N89-14598
MONNIG, CURTIS A. ..... N89-14272
MONTGOMERY, GERARD J. ..... N89-14763
MOORE, MARY ANNE ..... N89-14429
MOORE, RICHARD K. ..... N89-14479
MOORE, THOMAS C. ..... N89-14408
MOORE, THOMAS P. ..... N89-14676
N89-14677
MOREAU, DENNIS R. ..... N89-14956
N89-14962
N89-14975
N89-14979
N89-14980
N89-14983
N89-14984
N89-14985
N89-14991
N89-14992
MORELAND, JOHN ..... N89-14869
MORGAN, MICHAEL L. ..... N89-14764
MORLEY, BRUCE M. ..... N89-14540
MOROH, MARSHA ..... N89-14946
MOROZOV, S. I. ..... N89-14866
MORRISON, CLYDE A. ..... N89-14883
MORSE, J. D. ..... N89-14877
MOULIK, AMAL ..... N89-14943
MOUNT, G. H. ..... N89-14544
N89-14576
MOUROU, G. ..... N89-14434
MOYER, E. THOMAS, JR. ..... N89-14469
MULBRADON, MARGARET ..... N89-14438
MURCRAY, D. G. ..... N89-14547
MURCRAY, F. J. ..... N89-14547
MURPHY, D. M. ..... N89-14531
N89-14555
N89-14564
N89-14566
MYERS, THOMAS T. ..... N89-14228
MYSEN, B. O. ..... N89-15028

## N

NAGIB, HASSAN ..... N89-14242
NANDAGOPALAN, S. ..... N89-14806
NARIMAN, R. ..... N89-14712
NASH, ERIC R. ..... N89-14591
NASH, T. ..... N89-14733
NATKANETS, I. ..... N89-14866
NAYLOR, JOE ..... N89-14358
NEALY, JOHN E. ..... N89-15070
NEBEL, R. A. ..... N89-14855
NELSON, D. A. ..... N89-14275
NENNIE, E. ..... N89-14365
NESEL, MICHAEL C. ..... N89-14683
NESMITH, B. ..... N89-14831
NEUSCHAEFER, CARL H. ..... N89-14766
NEWCOMB, LINDA C. ..... N89-14920
NEWMAN, E. H. ..... N89-14725
NEWMAN, P. A. ..... N89-14568
NEWMAN, PAUL A. ..... N89-14506
N89-14507
N89-14511
N89-14516
N89-14584
NICKLING, WILLIAM G. ..... N89-15000
N89-15029
NIEBAUER, TIMOTHY MICHAEL ..... N89-14404
NIEMI, GERALD J. ..... N89-14614
NOAH, SHERIF T. ..... N89-14449
NOAKES, MARK W. ..... N89-14446
NOCK, L. A. ..... N89-14325
NOERDLINGER, PETER D. ..... N89-14825
NOGUEIRA, S. R. A. ..... N89-14812
NOIJ, THEODORUS HENRICUS ..... N89-14289
NOONAN, KEVIN W. ..... N89-14216
N89-14224
NORMAN, DONALD A. ..... N89-14690
NORTON, JEFFREY E. ..... N89-14775
NORTON, R. H. ..... N89-14546
NURMATOV ..... N89-14665
NUTH, J. ..... N89-15030
NUTH, JOSEPH A. ..... N89-15003
N89-15031
NUTH, JOSEPH A., III ..... N89-15001
NUTT, S. R. ..... N89-14260
NYITRAY, ALICE M. ..... N89-14315

## O

OBERBECK, V. R. ..... N89-14527
OBERGEFELL, LOUISE A. ..... N89-14685
N89-14688
ODORICO, J. ..... N89-14335
OKEEFE, M. A. ..... N89-14875
OLAGUAR, E. ..... N89-14590
OLSEN, K. B. ..... N89-14275
OLTMANS, S. J. ..... N89-14524
N89-14582
OLTMANS, SAMUEL J. ..... N89-14581
OMALLEY, M. W. ..... N89-14876
ONEAL, MELVIN R. ..... N89-14680
OPITZ, HAROLD H. ..... N89-14705
ORAILOGLU, ALEX ..... N89-14746
ORAN, E. S. ..... N89-14399
ORLANDO, JOHN J. ..... N89-14601
ORWOLL, ROBERT A. ..... N89-14921
ORZECHOWSKI, T. J. ..... N89-14436
OSHER, J. E. ..... N89-14410
OSOSKOV, G. A. ..... N89-14803
OSWALD, FRED B. ..... N89-14450
OWEN, JAMES W. ..... N89-14392
OWEN, P. R. ..... N89-15015
OWENS, JOHN K. ..... N89-14248
N89-14354

## P

PACIOREK, K. J. ..... N89-14309
PAEZ, THOMAS L. ..... N89-14460
PAGE, RICHARD A. ..... N89-14324
PALAMIDES, T. R. ..... N89-14257
PALLACKS, R. ..... N89-14737
PANI, ERIC ANDREW ..... N89-14636
PANOVA, E. YU. ..... N89-14788
PAPANTONI-KAZAKOS, P. ..... N89-14713
N89-14716
PAPENHAUSEN, DAVID W. ..... N89-14749
PARIS, D. T. ..... N89-14367
PARKER, FAUST R. ..... N89-14670
PARKER, LYNNE E. ..... N89-14687
PARKIN, S. S. P. ..... N89-14873
PARRISH, A. ..... N89-14548
N89-14549
PATERAKIS, MICHAEL ..... N89-14713
PATERSON, R. W. ..... N89-14221
PATRIKALAKIS, N. M. ..... N89-14778
PATTEN, WILLIAM N. ..... N89-14922
PAULSON, JOHN W., JR. ..... N89-14217
PAYDAS, ATIL ..... N89-14442
PAYNE, M. G. ..... N89-14429
PEKALA, R. W. ..... N89-14317
PENDLETON, GEOFFREY NELSON ..... N89-15064
PENZO, PAUL A. ..... N89-15032
PERKINS, A. LOUISE ..... N89-14786
PERSSON, K. B. ..... N89-14424
PESSOT, M. ..... N89-14434

PETERSON, RICHARD E. ..... N89-14582
PETROVA, L. V. ..... N89-14413
PETTERSON, D. ..... N89-14550
PFAENDTNER, JAMES ..... N89-14651
PFEILSTICKER, K. ..... N89-14574
PIA, STEPHEN H. ..... N89-14270
PICKERING, CYNTHIA K. ..... N89-14767
N89-14768
PIMENTEL, GEORGE C. ..... N89-14286
PIN, FRANCOIS G. ..... N89-14687
PINTO, ALBERT A. ..... N89-14883
PIOTROWSKI, JOSEPH ..... N89-14225
PIPITONE, FRANK ..... N89-14742
PITARI, GIOVANNI ..... N89-14529
PITTS, M. C. ..... N89-14515
PLACE, MICHAEL ..... N89-14480
PLENCNER, ROBERT M. ..... N89-14239
PODOLSKE, J. ..... N89-14567
PODOLSKE, J. R. ..... N89-14520
N89-14557
N89-14565
N89-14566
N89-14568
POLLOCK, WALTER H. ..... N89-14556
N89-14561
POMMEREAU, J. P. ..... N89-14577
POOL, SAM L. ..... N89-14676
N89-14677
POOLE, L. R. ..... N89-14531
N89-14532
POOLE, LAMONT R. ..... N89-14525
POPP, R. K. ..... N89-15014
POST, H. N. ..... N89-14498
POURAHMADI, MOHSEN ..... N89-14810
POWELL, CHERIE T. ..... N89-14991
POWELL, CHRISTOPHER A. ..... N89-14767
N89-14768
POWELL, J. A. ..... N89-14565
POWELL, RICHARD C. ..... N89-14883
PRAKASH, P. V. ..... N89-14778
PRATHER, MICHAEL J. ..... N89-14586
PRESTON, R. C. ..... N89-14819
PROBST, HUBERT B. ..... N89-14341
PROCTOR, MARGARET P. ..... N89-14255
PROFFITT, M. H. ..... N89-14520
N89-14564
N89-14565
N89-14568
PROFFITT, M. J. ..... N89-14554
PROKOPCHIK, A. YU. ..... N89-14271
PUESCHEL, R. F. ..... N89-14522
N89-14527
N89-14530
N89-14532
PUGH, E. ..... N89-14314
PULTZ, G. N. ..... N89-14426
PUZYNIN, I. V. ..... N89-14789
PYLE, J. A. ..... N89-14596
N89-14603

## Q

QUARLES, GREGORY J. ..... N89-14883
QUINTO, P. FRANK ..... N89-14213

## R

RACHELE, HENRY ..... N89-14625
RACHOVITSKY, E. ..... N89-14744
RADMAND, MANSOUR ..... N89-14735
RAGAN, ROBERT M. ..... N89-14480
RAJ, RISHI ..... N89-14261
RAMAMOORTHY, C. V. ..... N89-14711
RAMAN, GANESH ..... N89-14403
RAMASWAMY, V. ..... N89-14534
RAMESH, R. ..... N89-14874
RAMLI, MOHAMED DAHALAN MOHAMED ..... N89-14443
RANDEL, WILLIAM J. ..... N89-14507
RAPP, RITA M. ..... N89-14693
RAVISHANKARA, A. R. ..... N89-14544
REDDINGUIS, NICHOLAAS ..... N89-14818
REDNER, ALEX S. ..... N89-14468
REED, E. K. ..... N89-14370
REGELBRUGGE, MARC E. ..... N89-14474
REISTER, DAVID B. ..... N89-14446
REITELBACH, P. J. ..... N89-14519
REMICK, ROBERT J. ..... N89-14496
REUTHER, T. C. ..... N89-14854
RHEA, DONALD C. ..... N89-14683
RHODES, CHARLES K. ..... N89-14435
RHORER, RICHARD ..... N89-14445
RIBAUDO, C. ..... N89-14415
RIBE, F. L. ..... N89-14856
N89-14857
RICE, EDWARD J. ..... N89-14403
RICH, CHARLES ..... N89-14715
RICHARDSON, J. JEFFREY ..... N89-14740
N89-14752
N89-14769
RIETMAN, J. R. ..... N89-14632
RIETMEIJER, F. J. M. ..... N89-15025
RIFF, R. ..... N89-14457
RILEY, MICHAEL O. ..... N89-14316
RIVIR, RICHARD B. ..... N89-14400
RIYOPOULOS, S. ..... N89-14439
ROBERTS, GLYN O. ..... N89-14265
ROBERTS, J. P. ..... N89-14430
ROBINETT, RUSH DALETH, III ..... N89-14231
ROBINSON, D. N. ..... N89-14304
N89-14305
ROBINSON, M. A. ..... N89-14704
ROBINSON, S. P. ..... N89-14819
RODRIGUE, G. ..... N89-14786
RODRIGUEZ, JOSE M. ..... N89-14569
N89-14585
ROEHRIG, HANS ..... N89-14836
ROGACHEVA, I. V. ..... N89-14659
ROGERS, C. W. ..... N89-14642
ROMERO, E. ..... N89-14254
RONCIN, A. ..... N89-14674
ROODENBURG, J. ..... N89-14650
ROQUEMORE, LEROY ..... N89-14950
N89-14951
ROSEN, I. G. ..... N89-14798
ROSEN, J. M. ..... N89-14512
N89-14514
N89-14523
ROSEN, JAMES M. ..... N89-14524
ROSEN, RICHARD D. ..... N89-14597
ROSENAU, P. ..... N89-14855
ROSS, R. G., JR. ..... N89-14379
ROSSI, MICHEL J. ..... N89-14537
ROTHMAN, S. S. ..... N89-14409
ROUX, E. T. ..... N89-14602
ROWCLIFFE, A. F. ..... N89-14854
ROWLAND, F. S. ..... N89-14572
ROWLAND, F. SHERWOOD ..... N89-14606
ROYCE, W. ..... N89-14711
ROZOVSKIY, G. I. ..... N89-14271
RUBLEIN, GEORGE ..... N89-14923
RZASA, PETER ..... N89-14766
RZEPKA, W. ..... N89-14711

## S

SAARINEN, TUOMO ..... N89-14214
SAGE, LESLIE JOHN ..... N89-15058
SALAWITCH, R. J. ..... N89-14604
SALEHI, H. ..... N89-14800
SALSTEIN, DAVID A. ..... N89-14597
SAMOYLENKO, A. V. ..... N89-14665
SANCHEZ, L. ..... N89-14254
SANDER, STANLEY P. ..... N89-14599
N89-14607
SANDERS, R. W. ..... N89-14543
N89-14553
N89-14576
SANFORD, FIDELL ..... N89-14818
SANFORD, L. ..... N89-14526
SANTARIUS, JOHN F. ..... N89-14846
SARDAR, DHIRAJ K. ..... N89-14883
SASAKI, SHINOBU ..... N89-14782
SAUER, H. H. ..... N89-14619
SAUER, RICHARD L. ..... N89-14691
SAULYA, A. I. ..... N89-14662
SAUNDERS, R. STEPHEN ..... N89-15035
SAVAGE, M. ..... N89-14453
SAVAKIS, ANDREAS E. ..... N89-14385
SCANLON, CHARLES H. ..... N89-14924
SCARL, ETHAN A. ..... N89-14770
SCHAFER, R. W. ..... N89-14367
SCHAFFER, M. J. ..... N89-14858
SCHAPER, P. W. ..... N89-14546
N89-14550
SCHARNHORST, D. A. ..... N89-14753
SCHIFLETT, SAMUEL G. ..... N89-14670
SCHLACHTER, J. S. ..... N89-14855
SCHMALE, D. T. ..... N89-14296
SCHMELTEKOPF, A. L. ..... N89-14543
N89-14544
N89-14553
N89-14576
SCHMIDT, RODNEY C. ..... N89-14218
SCHMIDT, U. ..... N89-14573
SCHMITT, HARRISON H. ..... N89-14843
N89-14849
SCHMOLL, W. J. ..... N89-14281
SCHNEIDER, B. I. ..... N89-14780
SCHNELL, RUSSELL C. ..... N89-14581
N89-14582
SCHOEBERL, MARK R. ..... N89-14505
N89-14506
N89-14516
N89-14568
N89-14584
SCHOENBERG, KURT F. ..... N89-14861
SCHOENMAN, LEONARD ..... N89-14256
SCHOLTEN, WIM ..... N89-14728
SCHOUTEN, BERT ..... N89-14728
N89-14729
SCHUBERT, B. ..... N89-14573
SCHULTZ, JOHN R. ..... N89-14691
SCHULTZ, PETER H. ..... N89-14999
N89-15033
N89-15034
SCHUPP, DONALD A. ..... N89-14310
SCHWARTZ, ROBERT N. ..... N89-14834
SCHWARZ, RAY ..... N89-14666
SCOTT, CHARLES D. ..... N89-14667
SCOTT, STAN G. ..... N89-14560
N89-14562
SCRIMGER, P. ..... N89-14483
SCUDDER, D. W. ..... N89-14855
SEAH, M. P. ..... N89-14724
SEAMSTER, THOMAS L. ..... N89-14686
SEASTEDT, T. R. ..... N89-14637
SECHRIST, FRANK ..... N89-14505
SEE, T. H. ..... N89-15008
SEGAL, H. M. ..... N89-14616
SEIFFERT, M. ..... N89-15068
SHAIKH, ANEESA BASHIR ..... N89-14971
SHAMSUZZOHA, M. ..... N89-14294
SHAW, FREDERICK J. ..... N89-14339
N89-14773
SHEALY, MARILYN ..... N89-14668
SHEFFIELD, JOHN ..... N89-14859
SHENSA, M. J. ..... N89-14253
SHERBROOKE, CRAIG C. ..... N89-14234
SHERIDAN, PATRICK J. ..... N89-14581
N89-14582
SHERMAN, S. ..... N89-14711
SHETTY, DINESH K. ..... N89-14463
SHIA, R. L. ..... N89-14595
SHIBUKI, KUNIO ..... N89-14870
SHIRLEY, MARK HARPER ..... N89-14741
SHOFNER, WILLIAM P. ..... N89-14673
SHUH, DAVID K. ..... N89-14302
SHVACHKA, A. B. ..... N89-14788
SIBENER, STEVEN J. ..... N89-14826
SIIKONEN, TIMO ..... N89-14214
SILADIC, MATO F. ..... N89-14219
SIMITSES, G. J. ..... N89-14457
SIMMONDS, IAN ..... N89-14638
SIMMS, GREG ..... N89-14823
SIMONS, J. M. ..... N89-14357
SINYAKOV, V. S. ..... N89-14660
SIRCAR, S. ..... N89-14415
SITTERS, CORNELIUS WILHELMUS MARIA ..... N89-14727
SKEBE, S. A. ..... N89-14221
SKEEL, R. D. ..... N89-14783
SKOOG, A. I. ..... N89-14254
SLAGMOLEN, J. W. ..... N89-14489
SLATER, TIMOTHY ..... N89-14670
SLAVIN, S. E. ..... N89-14426
SLAY, F. M. ..... N89-14234
SLINEY, HAROLD E. ..... N89-14338
SLINGERLAND, HENDRIK NICOLAS ..... N89-14350
SLOVIC, PAUL ..... N89-14936
SMART, DAVID W. ..... N89-14734
SMIALEK, JAMES L. ..... N89-14297
SMITH, D. L. ..... N89-14617
N89-14854
SMITH, JAMES E., JR. ..... N89-14417
SMITH, M. H. ..... N89-14643
SMITH, R. N. ..... N89-14617
SMITH, S. D. ..... N89-14541
SMITH, SUZANNE WEAVER ..... N89-14925
SMITH, TERENCE ..... N89-14481
SMITH, THOMAS R. ..... N89-14863
SNETSINGER, K. G. ..... N89-14527
N89-14530
SNODGRASS, THOMAS D. ..... N89-14760
SNOEK, M. ..... N89-14656
SNYDER, CATHERINE E. ..... N89-14686
SNYDER, CHRISTOPHER A. ..... N89-14237
SOLOMON, P. ..... N89-14548
N89-14549
SOLOMON, S. ..... N89-14543
N89-14553
N89-14576
SONDERGAARD, NEAL A. ..... N89-14841
SONETT, C. P. ..... N89-15012
SORENSEN, MICHAEL ..... N89-15000
SPANJER, D. J. ..... N89-14730
SPEICH, G. R. ..... N89-14298
SPENCER, JOHN H. ..... N89-14896

SPERRY, P. D. ..... N89-14526
SPICER, C. W. ..... N89-14617
SPICUZZA, RONALD J. ..... N89-14670
SPIJKERVERT, WIM ..... N89-14729
SPRADLEY, L. W. ..... N89-14704
SQUIER, J. ..... N89-14434
SQUYRES, STEVEN ..... N89-15001
SRINATH, V. ..... N89-14712
SRINIVASAN, SHIVAKUMAR ..... N89-14401
STADLER, CONNIE R. ..... N89-14693
STALLINGS, ROBERT L., JR. ..... N89-14232
N89-14233
STALNAKER, J. F. ..... N89-14704
STAR, JEFFREY L. ..... N89-14481
STARK, LOUISE ..... N89-14720
STARR, WALTER L. ..... N89-14520
N89-14552
N89-14554
N89-14567
N89-14575
STEARNS, CHARLES R. ..... N89-14517
STEARNS, SAMUEL D. ..... N89-14368
STEENEKEN, H. J. M. ..... N89-14945
STEIN, GUNTER ..... N89-14377
STEINER, DON ..... N89-14844
STENBERG, D. R. ..... N89-14412
STEPHENS, J. J. ..... N89-14296
STEPHENS, JAMES ..... N89-15003
N89-15035
STEPHENS, SALLY ANNE ..... N89-15049
STEPOCHKINA, N. A. ..... N89-14664
STEWART, JAMES M. ..... N89-14886
STEWART, SUSAN A. ..... N89-14883
STEWMAN, JOHN ..... N89-14720
STITES, JOHN, JR. ..... N89-14306
STOEHR, R. A. ..... N89-14712
STOLARSKI, RICHARD S. ..... N89-14571
N89-14584
STOUGHTON, JOHN W. ..... N89-14385
STRAHAN, S. E. ..... N89-14520
N89-14557
N89-14566
STRICKLAND, D. ..... N89-14434
STRONG, IAN ..... N89-15003
STUCKI, L. ..... N89-14711
STUFFLE, KEVIN ..... N89-14463
SUBRAMANIAN, R. ..... N89-14415
SULLIVAN, V. ..... N89-14326
SUMIN, V. V. ..... N89-14866
SUTER, U. W. ..... N89-14321
SUZUKI, HISASHI ..... N89-14870
SVIATOSLAVSKY, I. N. ..... N89-14848
SWANSON, P. L. ..... N89-14257
SWEEDLER, JONATHAN V. ..... N89-14288
N89-14382
SWINDEMAN, R. W. ..... N89-14304
SYRETT, W. J. ..... N89-14626
SZE, NIEN-DAK ..... N89-14569
N89-14585
SZEDLMAYER, MARGARET M. ..... N89-14525

## T

TABACK, ISRAEL ..... N89-14428
TALLMAN, C. R. ..... N89-14430
TALMADGE, RICHARD D. ..... N89-14735
TAMANO, T. ..... N89-14858
TANG, C. M. ..... N89-14439
TANG, GILBERT HEI YIN ..... N89-14267
TANNER, W. G. ..... N89-15007
TARKENTON, G. M. ..... N89-14820
TAYLOR, A. J. ..... N89-14430
TAYLOR, P. L. ..... N89-14858
TAYLOR, S. ..... N89-14510
TENNEY, DARREL R. ..... N89-14264
TERAMURA, ALAN H. ..... N89-14613
TERRANOVA, MICHELE ..... N89-14686
TESSEMA, ASHENAFI ..... N89-14269
THELIN, BO ..... N89-14623
THODE, L. E. ..... N89-14356
THOENES, J. ..... N89-14704
THOMANN, R. V. ..... N89-14615
THOMAS, G. ..... N89-14874
THOMAS, M. G. ..... N89-14498
THOMSON, D. W. ..... N89-14626
THORNTON, WILLIAM E. ..... N89-14676
N89-14677
THRONE, JAMES L. ..... N89-14926
TIMMERMANS, CORNELIS ALBERTUS ..... N89-14813
TINGEY, DAVID T. ..... N89-14608
TKACHENKO, B. I. ..... N89-14665
TOGAI, MASAKI ..... N89-14771
TOLBERT, MARGARET A. ..... N89-14537
TOLPADI, ANIL KUMAR ..... N89-14388
TONG, FRANKLIN FUK-KAY ..... N89-14425
TOOHEY, D. W. ..... N89-14575
TOON, B. ..... N89-14530
TOON, GOEFF C. ..... N89-14528
N89-14546
N89-14550
TOON, O. B. ..... N89-14535
TOON, OWEN B. ..... N89-14528
N89-14536
TORRES, ARNOLD L. ..... N89-14518
TOWNE, DOUGLAS M. ..... N89-14750
TOWNSEND, D. P. ..... N89-14452
TOWNSEND, LAWRENCE W. ..... N89-15070
TOWSEND, WILLIAM ..... N89-14689
TRANGELED, A. ..... N89-14483
TRAVALE, DAVID J. ..... N89-14670
TREIMAN ..... N89-15042
N89-15043
N89-15044
N89-15045
TREPTE, C. R. ..... N89-14521
N89-14532
TRIANTAFYLLOPOULOS, SPIROS ..... N89-14956
N89-14962
N89-14969
N89-14970
N89-14976
N89-14977
N89-14980
N89-14982
N89-14986
TRIGG, GLENN ..... N89-14638
TRINH, EUGENE H. ..... N89-14422
TRIPP, DAVID E. ..... N89-14470
TRUNK, G. V. ..... N89-14361
TSAI, C. T. ..... N89-14887
TSAI, CHEN S. ..... N89-14835
TSAO, ALAN ..... N89-14927
TSO, TAI-LY ..... N89-14598
TSVINEVA, G. P. ..... N89-14413
TUCK, A. F. ..... N89-14563
N89-14564
N89-14565
N89-14566
TUCK, ADRIAN ..... N89-14525
TUCKER, D. W. ..... N89-15026
TUNG, K. K. ..... N89-14590
TURCO, R. P. ..... N89-14535
TURCO, RICHARD ..... N89-14536
TUREK, R. O. ..... N89-14719
TURLEY, R. S. ..... N89-14440
TURNBULL, A. ..... N89-14301
TURNER, GREGORY A. ..... N89-14883
TURNER, JAMES C., JR. ..... N89-14928
TUTTLE, MARK E. ..... N89-14929
TYLER, DAVID ..... N89-14279

## U

ULABY, F. T. ..... N89-14621
UMEZAWA, A. ..... N89-14872
UNCAPHER, W. L. ..... N89-14412
UNDERWOOD, PHILLIP ..... N89-14473
URI, JOHN J. ..... N89-14676
N89-14677
URYU, M. ..... N89-14592

## V

VAETH, R. ..... N89-14254
VALLINGA, PAUL MARTIN ..... N89-14865
VANDELINDE, F. J. G. ..... N89-14692
VANDENWOLLENBERG, ARNOLD L. ..... N89-14801
VANDEVENDER, J. P. ..... N89-14862
VANDOREN, JANE ..... N89-14538
VANETTEN, R. P. ..... N89-14492
VANGESSEL, J. C. A. ..... N89-14372
VANGILS, WILLIBRORDUS JOHANNES ..... N89-14371
VANHAAFTEN, F. ..... N89-14830
VANHORSSEN, WILHELM TENIUS ..... N89-14796
VANLIEBURG, ERNST ..... N89-14728
VANNORMAN, JOHN D. ..... N89-14930
VANWINSUM-WESTRA, M. ..... N89-14678
VANZUYLEN, P. ..... N89-14454
VARSAMIS, GEORGIOS ..... N89-14844
VEDDER, J. F. ..... N89-14561
VEDDER, JAMES F. ..... N89-14552
N89-14556
N89-14567
VERHOEF, HEDWIG ..... N89-14491
VERINK, E. D. ..... N89-14293
VERMA, S. ..... N89-14527
N89-14530
VERMEIJ, KEES ..... N89-14728
VERSLEYEN, M. P. J. G. ..... N89-14495
VESEY, ROGER ..... N89-14844
VIGIL, F. J. ..... N89-14296
VIRKAR, ANIL V. ..... N89-14463
VISCONTI, GUIDO ..... N89-14529
VISENTINE, JAMES T. ..... N89-14331
N89-14332
VISSER, MARIJKE ..... N89-14657
VOGEL, J. ..... N89-14454
VOLOSHIN, ARKADY S. ..... N89-14468
VREE, WIM ..... N89-14729
VYDYANATH, HONNAVALLI R. ..... N89-14880

## W

WADE, WILLIAM R. ..... N89-14374
WADIAK, E. JAMES ..... N89-14252
WAGEMAKERS, JAN ..... N89-14728
WAGNER, KEN ..... N89-14502
WAHNER, A. ..... N89-14544
WALDMAN, C. H. ..... N89-14628
WALKER, WILLIAM J. ..... N89-14686
WALKUP, CONNIE M. ..... N89-14316
WALLS, F. L. ..... N89-14424
WALLSTEN, THOMAS S. ..... N89-14808
WALRAFEN, G. E. ..... N89-14314
WALTER, L. S. ..... N89-15036
WALTERS, E. JANE ..... N89-14375
WALTMAN, DONNA P. ..... N89-14270
WANG, FRANK C.-Y. ..... N89-14598
WANG, ROSIE RONG LING ..... N89-14291
WANG, T. F. ..... N89-14356
WARDE, CARDINAL ..... N89-14772
WARK ..... N89-15042
N89-15043
N89-15044
N89-15045
WASHBURN, J. ..... N89-14875
WATANABE, HIROYUKI ..... N89-14771
WATSON, E. B. ..... N89-15037
WATSON, FREDERICK GARNETT ..... N89-15048
WATSON, LYN ..... N89-14538
WATTLE, B. J. ..... N89-14642
WATTS, MICHAEL E. ..... N89-14216
WAY, JOHN L. ..... N89-14242
WDOWIAK, THOMAS J. ..... N89-15031
WEERS, C. A. ..... N89-14838
WEIKLE, DONALD H. ..... N89-14418
WEIR, THOMAS E., JR. ..... N89-14939
WEISENSTEIN, DEBRA K. ..... N89-14585
WELCH, RONALD M. ..... N89-14931
WELCH, T. ..... N89-14711
WELLEMEYER, C. ..... N89-14510
WEN, J. S. ..... N89-14595
WERLEY, KENNETH A. ..... N89-14860
WERNER, B. T. ..... N89-15038
WERNER, BRAD ..... N89-15001
WESCOURT, KEITH T. ..... N89-14767
N89-14768
WESTERBERG, STEFAN ..... N89-14353
WESTFOLD, S. ..... N89-14707
WHITE, BRUCE ..... N89-15000
WHITE, BRUCE R. ..... N89-15021
N89-15022
N89-15039
WHITE, LISA KAY ..... N89-14478
WHITNEY, GRETCHEN ..... N89-14940
WIEDEMEIER, H. ..... N89-14868
WIERINGA, ROEL ..... N89-14739
WIESENBURG, DENIS A. ..... N89-14655
WIESNET, DONALD ..... N89-14480
WIJBRANDS, RUDOLF JOHANNES ..... N89-14738
WILCOX, FLOYD J., JR. ..... N89-14232
N89-14233
WILKERSON, MARK ..... N89-14315
WILLIAMS, BRIAN C. ..... N89-14743
WILLIAMS, DAVID ..... N89-14242
WILLIAMS, JOEL M. ..... N89-14315
WILLIAMS, R. J. ..... N89-15023
WILLIAMS, R. STANLEY ..... N89-14302
N89-14887
WILLIAMS, RICHARD J. ..... N89-14998
N89-15040
WILLIAMSON, R. L. ..... N89-14292
WILLIAMSON, SAMUEL J. ..... N89-14681
WILMOT, ROGER ..... N89-14363
WILSON, DANIEL A. ..... N89-14273
WILSON, J. C. ..... N89-14531
N89-14541
WILSON, JOHN W. ..... N89-15070
WINCHESTER, JOHN W. ..... N89-14581
WINEFORDNER, J. D. ..... N89-14276
WINKLER, S. ..... N89-14467
WISNIEWSKI, P. ..... N89-14712
WOESSNER, LINDA H. ..... N89-14994
WOFSY, S. C. ..... N89-14604

WOLF, DAVID A. ..... N89-14666
WOLF, J. ..... N89-14652
WOLFE, J. H. ..... N89-15041
WOLFE, JOHN ..... N89-15001
N89-15003
WOODRUFF, G. L. ..... N89-14857
WORSNOP, DOUGLAS ..... N89-14538
WRIGHT, MARY A. ..... N89-14474
WRIGHT, T. ..... N89-14785
WU, MAO-FOU ..... N89-14591
WU, SHERMAN S. C. ..... N89-15046
WYMAN, CHARLES E. ..... N89-14667
WYSIN, G. M. ..... N89-14394

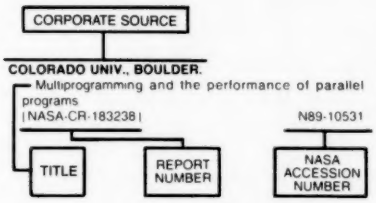
## Y

YAMALEEV, R. M. ..... N89-14787
YAN, LIN ..... N89-14985
YANEY, P. P. ..... N89-14281
YANG, H. ..... N89-14590
YAO, KUNG ..... N89-14795
YEH, HSIEN-YANG ..... N89-14456
YEH, R. ..... N89-14711
YERLYKIN, L. A. ..... N89-14245
YONG, YOOK-KONG ..... N89-14882
YOUNG, FREDERICK J. ..... N89-14841
YOUNG, L. ..... N89-14432
YOUNGS, DOUGLAS ..... N89-14721
YUDIN, M. ..... N89-14828
YUNG, YUK L. ..... N89-14595

## Z

ZAHNISER, MARK ..... N89-14538
ZANETTE, S. I. ..... N89-14812
ZANNER, F. J. ..... N89-14292
ZAPOTOSKY, JOHN E. ..... N89-14360
ZAVODNEY, LAWRENCE D. ..... N89-14932
ZELLNER, JOHN W. ..... N89-14228
ZHANLAV, T. ..... N89-14789
ZHIDKO, YU. M. ..... N89-14366
ZIEREIS, H. ..... N89-14574
ZIOCK, K. P. ..... N89-15068
ZIRILLI, FRANCESCO ..... N89-14793
ZUCKERWAR, ALLAN J. ..... N89-14407
ZUREK, R. W. ..... N89-14595
ZUTAVERN, F. J. ..... N89-14876
ZWAAL, A. ..... N89-14244
ZWANN, R. J. ..... N89-14223
ZWINDERMAN, AEILKO H. ..... N89-14801

### Typical Corporate Source Index Listing

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## A


**ACADEMY OF SCIENCES OF THE UKRAINIAN SSR, KHARKOV.**
DIMOD program complex for dynamic simulation of defects in metals and alloys
| DE88-703787 | N89-14295

**ACADEMY OF SCIENCES (USSR), MOSCOW.**
The Baksan Neutrino Observatory Soviet-American Gallium Solar Neutrino Experiment
| DE89-000375 | N89-15061

**AERODYNE RESEARCH, INC., BILLERICA, MA.**
Mass accommodation coefficient measurements for HNO3, HCl and N2O5 on water, ice and aqueous sulfuric acid droplet surfaces N89-14538

**AEROJET ELECTROSYSTEMS CO., AZUSA, CA.**
Hg,CdTe material optimization for carrier lifetime maximization
| AD-A198101 | N89-14880

**AEROJET SOLID PROPULSION CO., SACRAMENTO, CA.**
The synthesis of carborane-oxetane monomers and their polymerization
| AD-A198596 | N89-14330

**AEROJET TECHSYSTEMS CO., SACRAMENTO, CA.**
Orbit transfer rocket engine technology program: Oxygen materials compatibility testing
| NASA-CR-182195 | N89-14256

**AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OH.**
Comparison of the general dynamics ground clobber algorithm with the GCAS and laws algorithms
| AD-A198479 | N89-14226
Reconfigurable flight control: An opportunity for integrated diagnostics N89-14744

**AEROSPACE MEDICAL RESEARCH LABS., WRIGHT-PATTERSON AFB, OH.**
Further investigation of contrast sensitivity and visual acuity in pilot detection of aircraft
| AD-A198434 | N89-14680
Articulated total body model enhancements. Volume 1: Modifications
| AD-A198726 | N89-14685
Articulated total body model enhancements. Volume 3: Programmer's guide
| AD-A197940 | N89-14688

**AEROSPATIALE, SURESNES (FRANCE).**
Metal-metal bonding: Contribution to the study of aging. Test report 48-453/F
| REPT-48-453/F | N89-14335
Influence of the application parameters of primer coats for bonding. Test report 49-064/F
| REPT-49-064/F | N89-14336

**AIR FORCE ARMAMENT LAB., EGLIN AFB, FL.**
Expert Missile Maintenance Aid (EMMA): An application of artificial intelligence technology to the munition maintenance domain N89-14748

**AIR FORCE FLIGHT DYNAMICS LAB., WRIGHT-PATTERSON AFB, OH.**
High speed data acquisition systems
| AD-A198194 | N89-14735
Reconfigurable flight control: An opportunity for integrated diagnostics N89-14744

**AIR FORCE GEOPHYSICS LAB., HANSCOM AFB, MA.**
Possible measurement errors in calibrated AVHRR (Advanced Very High Resolution Radiometer) data
| AD-A198342 | N89-14414

**AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OH.**
Numerical grid generation and potential airfoil analysis and design
| AD-A197972 | N89-14219
Some wind characteristics of Kahe Point, O'ahu and vicinity
| AD-A197969 | N89-14644

**AIR FORCE SYSTEMS COMMAND, WRIGHT-PATTERSON AFB, OH.**
Antenna arrays with increasing according to arithmetical progression distances between the emitters
| AD-A198644 | N89-14366

**AIR FORCE WRIGHT AERONAUTICAL LABS., WRIGHT-PATTERSON AFB, OH.**
A numerical simulation of the flow field and heat transfer in a rectangular passage with a turbulence promoter
| AD-A198579 | N89-14400
The B-1B central integrated test system expert parameter system N89-14763

**AKRON UNIV., OH.**
A viscoplastic constitutive model for anisotropic metals at high temperature N89-14305
Polymer powder prepregging: Scoping study N89-14926

**ALABAMA UNIV., HUNTSVILLE.**
Development of an endoscopic probe for radial metrology
| NASA-CR-184577 | N89-14417

**ALLIED-SIGNAL CORP., KANSAS CITY, MO.**
Infrared temperature monitoring and control of final solder-joint temperature on flat flex cables
| DE89-000409 | N89-14349

**ALLIED-SIGNAL CORP., MORRISTOWN, NJ.**
Chirped pulse amplification: Present and future
| DE89-001016 | N89-14434

**APPLIED SOLAR ENERGY CORP., CITY OF INDUSTRY, CA.**
Rugged, thin GaAs solar cell development
| AD-A198533 | N89-14502

**AQUILA UNIV. (ITALY).**
Formation of polar stratospheric clouds simulated in a two dimensional model of the atmosphere N89-14529

**ARGONNE NATIONAL LAB., IL.**
Laser-driven polarized sources of hydrogen and deuterium
| DE89-000541 | N89-14432
ELEFUNT test results under FORTRAN-PLUS on the active memory technology DAP 510-8
| DE88-017264 | N89-14700
Critical fields and characteristic lengths in copper oxide superconductors
| DE89-000543 | N89-14872
Magnetic field penetration into the high temperature superconductor YBa2Cu3O(sub 7-x)
| DE89-000547 | N89-14873

**ARIZONA STATE UNIV., TEMPE.**
Evaluation of microwave anechoic chamber absorbing materials
| AD-A198055 | N89-14320
Design and calibration of the carousel wind tunnel N89-15021
Development and testing of a unique carousel wind tunnel to experimentally determine the effect of gravity and the interparticle force on the physics of wind-blown particles N89-15022
Cautionary tales for reduced-gravity particle research N89-15026
Electrostatic aggregation of finely-comminuted geological materials N89-15027

**ARIZONA UNIV., TUCSON.**
The future of intelligent spectrometers in metal speciation by atomic emission spectrometry
| AD-A198592 | N89-14287
Molecular spectroscopy using charge transfer device detectors
| AD-A198593 | N89-14288
Grain boundary phase equilibria in metallic systems
| DE89-000026 | N89-14294
Comparison of charge transfer device and photomultiplier tube performance for extremely low photon fluxes
| AD-A198594 | N89-14382
Expert systems to give installation advice for UNIX 4.2BSD and to help connect a terminal to a computer N89-14755
Detector evaluation for optical signals
| AD-A198133 | N89-14836
The effect of torch pressure on analyte response in a 27 MHz inductively coupled plasma
| AD-A198595 | N89-14863
Benchmark solutions for the galactic ion transport equations with spatial and energy coupling N89-14907
Experimental constraints on heating and cooling rates of refractory inclusions in the early solar system N89-15042
Experimental constraints on the origin of chondrules N89-15043
Experimental correlation of melt structures, nucleation rates, and thermal histories of silicate melts N89-15044
Containerless high-pressure petrology experiments in the microgravity environment of the Space Station N89-15045

**ARKANSAS STATE UNIV., STATE UNIVERSITY.**
A flight test design for studying airborne applications of air to ground duplex data link communications N89-14924

**ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, WATERVLIET, NY.**
Discussion and explanation of unplanned ignition incident: Ignition caused by rapid pressurization of a propellant containing bubbles
| AD-A198419 | N89-14340

**ARMY AVIATION ENGINEERING FLIGHT ACTIVITY, EDWARDS AFB, CA.**
Evaluation of the improved OV-1D anti-icing system
| AD-A198438 | N89-14225

**ARMY AVIATION RESEARCH AND DEVELOPMENT COMMAND, CLEVELAND, OH.**
Improvement in finite element meshes: Heat transfer in an infinite cylinder
| NASA-TM-101410 | N89-14450
The role of thermal and lubricant boundary layers in the transient thermal analysis of spur gears
| NASA-TM-101435 | N89-14452

**ARMY CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, IL.**
DEH (Directorates of Engineering and Housing) automated graphics guide: Selection, acquisition, implementation, and management
| AD-A198489 | N89-14721

**ARMY LAB. COMMAND, WATERTOWN, MA.**
Low temperature heat capacities of several high strength materials
| AD-A198300 | N89-14299

**ARMY RESEARCH INST. OF ENVIRONMENTAL MEDICINE, NATICK, MA.**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
| AD-A197472 | N89-14668

**ASTRONAUTICS TECHNOLOGY CENTER, MADISON, WI.**
Synergism of He-3 acquisition with lunar base evolution N89-14852

**ATMOSPHERIC AND ENVIRONMENTAL RESEARCH, INC., CAMBRIDGE, MA.**
Photochemical modeling of the Antarctic stratosphere: Observational constraints from the airborne Antarctic ozone experiment and implications for ozone behavior N89-14569
Antarctic ozone decrease: Possible impact on the seasonal and latitudinal distribution of total ozone as simulated by a 2-D model N89-14585
Use of operational analyses to study the dynamics of troposphere-stratosphere interactions in polar regions N89-14597

**ATMOSPHERIC ENVIRONMENT SERVICE, DOWNSVIEW (ONTARIO).**
CANOZE measurements of the Arctic ozone hole N89-14578
Brewer spectrophotometer measurements in the Canadian Arctic N89-14579

**AUTOMATED REASONING CORP., NEW YORK, NY.**
IN-ATE: Fault diagnosis as expert system guided search N89-14757

## B

**BALLISTIC RESEARCH LABS., ABERDEEN PROVING GROUND, MD.**
A preliminary report on developing an expert system for computer-aided formulation of propellants [AD-A198088] N89-14339
Modern computer-aided tools for high-resolution weapons system engineering [AD-A197855] N89-14710
An evaluation of five PC-based expert system shells [AD-A197915] N89-14773

**BATTELLE COLUMBUS LABS., OH.**
Development of a rotary valve for pulse combustion applications [PB88-250568] N89-14444
Aircraft emissions characterization [AD-A197864] N89-14617

**BAYLOR UNIV., WACO, TX.**
Investigation of the enhanced spatial density of submicron lunar ejecta between L values 1.2 and 3.0 in the earth's magnetosphere: Theory N89-15007

**BEAZLEY (WILLIAM G.) AND ASSOCIATES, HOUSTON, TX.**
Expert system rules from CAD databases N89-14756

**BETHUNE-COOKMAN COLL., DAYTONA BEACH, FL.**
Computer modeling of polymers N89-14910

**BIONETICS CORP., COCOA BEACH, FL.**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise [AD-A197472] N89-14668

**BOEING ADVANCED SYSTEMS CO., SEATTLE, WA.**
Fire extinguishing agent evaluation in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS) [AD-A198523] N89-14227

**BOEING AEROSPACE CO., HUNTSVILLE, AL.**
Space station commonality analysis [NASA-CR-179422] N89-14251

**BOEING AEROSPACE CO., SEATTLE, WA.**
Aeroassisted orbital transfer vehicle control technology [NASA-CR-179424] N89-14250
A maintenance and diagnostic information system N89-14754

**BOEING COMPUTER SERVICES CO., SEATTLE, WA.**
Ordering methods for sparse matrices and vector computers [AD-A198291] N89-14717

**BOEING MILITARY AIRPLANE DEVELOPMENT, SEATTLE, WA.**
CEPS: An artificial intelligence approach to avionics maintenance N89-14749

**BOLT, BERANEK, AND NEWMAN, INC., CANOGA PARK, CA.**
Detailed design specification for a prototype Assessment System for Aircraft Noise (ASAN) [AD-A197936] N89-14818

**BOSTON COLL., CHESTNUT HILL, MA.**
Spectroscopic investigation of the Cr to Tm energy transfer in Yttrium Aluminum Garnet (YAG) crystals N89-14903

**BROWN UNIV., PROVIDENCE, RI.**
Running a large Monte Carlo Program in a farm of MicroVAX-II computers under VAXELIN [DE88-012761] N89-14732
Debris-cloud collisions: Accretion studies in the Space Station N89-15033
Impacts of free-floating objects: Unique Space Station experiments N89-15034

**BRUNEL UNIV., UXBRIDGE (ENGLAND).**
Tribological characteristics of coatings on aluminium and its alloys N89-14290

## C

**CAIRO UNIV. (EGYPT).**
Effects of core turbulence on jet excitability [NASA-TM-101405] N89-14403

**CALIFORNIA INST. OF TECH., PASADENA.**
Determination of convergence rates across the Ventura Basin, Southern California, using GPS and historical triangulation [NASA-CR-183014] N89-14624
A planetary ultra hypervelocity impact mechanics and shock wave science facility N89-15005
Proposed earth-based cratering experiments at low g in hard vacuum N89-15006
Grain dynamics in zero gravity N89-15038

**CALIFORNIA STATE UNIV. AT LONG BEACH.**
Temperature effect on stress concentration around circular hole in a composite material specimen representative of X-29A forward-swept wing aircraft [NASA-CR-179439] N89-14456

**CALIFORNIA UNIV., BERKELEY.**
Transient behaviors in chemical reactions: Nanosecond infrared spectroscopy, chemically pumped visible and near-IR lasers [AD-A198484] N89-14286
Equivalent linearization for fatigue life estimates of a nonlinear structure N89-14919

**CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.**
Progress and prospects in soft X-ray holographic microscopy [DE88-016638] N89-14409
Bi-Ca-Sr-Cu-O superconductors: The connectivity issue [DE89-000558] N89-14874
Inversion boundaries in GaAs grown on Si [DE89-000568] N89-14875

**CALIFORNIA UNIV., DAVIS.**
Aerodynamic and kinetic processes in flames [AD-A198474] N89-14284
Computation of canonical correlation and best predictable aspect of future for time series [NASA-CR-184655] N89-14810
Aeolian processes aboard a Space Station: Saltation and particle trajectory analysis N89-15039

**CALIFORNIA UNIV., IRVINE.**
Wintertime losses of ozone in high northern latitudes N89-14572
Stratospheric feedback from continued increases in tropospheric methane N89-14606
Integrated acoustooptic device modules for optical information processing [AD-A198061] N89-14835

**CALIFORNIA UNIV., LOS ANGELES.**
Ternary solid phase equilibria in the systems (Ag,In,Au)-(Cd,He)-Te [AD-A198679] N89-14302
Research instrumentation for computer vision, image understanding and optical computing [AD-A198578] N89-14723
A survey of the state-of-the-art and focused research in range systems [NASA-CR-184595] N89-14726
Efficient load measurements using singular value decomposition [NASA-CR-184614] N89-14795
The physics of the high density Z-pinch [DE88-016147] N89-14855
Solid phase equilibria in the Pt-Ga-As and Pt-Ga-Sb systems [AD-A198654] N89-14887

**CALIFORNIA UNIV., RIVERSIDE.**
Electron acceleration by laser fields in a gas [DE89-000567] N89-14433

**CALIFORNIA UNIV., SAN DIEGO, LA JOLLA.**
Firefly luciferase-structure and function [AD-A198292] N89-14283
Computation via direct manipulation [AD-A198417] N89-14690

**CALIFORNIA UNIV., SANTA BARBARA.**
Remote sensing information sciences research group [NASA-CR-183374] N89-14481
Semiclassical corrections for inelastic atom-surface scattering from classical trajectories [AD-A198636] N89-14827

**CALIFORNIA UNIV., SANTA CRUZ.**
Optical spectroscopy of X-ray: Selected active galactic nuclei N89-15049

**CALSPAN ADVANCED TECHNOLOGY CENTER, BUFFALO, NY.**
Aerosol characteristics in the Marine Boundary Layer over the Straits of Gibraltar, June 1986 [AD-A197945] N89-14642

**CALSPAN-BUFFALO UNIV. RESEARCH CENTER, NY.**
Development of BEM for ceramic composites [NASA-CR-183313] N89-14311

**CALSPAN CORP., BUFFALO, NY.**
The effect of pyridostigmine bromine on inflight aircrew performance [AD-A198828] N89-14670

**CAMBRIDGE UNIV. (ENGLAND).**
Polar vortex dynamics N89-14588
On the origin of steep edges and filaments in vorticity and potential vorticity fields N89-14593
High-resolution dynamical modelling of the Antarctic stratospheric vortex N89-14594
Modelling the Antarctic lower stratosphere N89-14603

**CARLOW ASSOCIATES, INC., FAIRFAX, VA.**
Human factors in the Naval Air Systems Command: Computer based training [DE88-015301] N89-14686

**CARNEGIE INSTITUTION OF WASHINGTON, DC.**
Crystal-liquid-vapor equilibrium experiments at high temperature (less than or equal to 1800 C) and low, controlled oxygen and hydrogen pressure (10(-1) to 10(-9) PA) N89-15028

**CARNEGIE-MELLON UNIV., PITTSBURGH, PA.**
Rheological and rheo-optical studies with nematogenic solutions of a rodlike polymer: A review of data on poly(phenylene benzobisthiazole) [AD-A197994] N89-14318
Rheological studies on blends of rodlike and flexible chain polymers [AD-A198455] N89-14326
Distributed diagnostic performance reporting and analysis N89-14762

**CASE WESTERN RESERVE UNIV., CLEVELAND, OH.**
Predicted performance of a prototype solar neutron detector N89-15064

**CATHOLIC UNIV. OF AMERICA, WASHINGTON, DC.**
Application of linear response theory to experimental data of simultaneous radiation and annealing response of a CMOS device [NASA-CR-183401] N89-14871

**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, VERRIERES-LE BUISSON (FRANCE).**
Ozone and nitrogen dioxide ground based monitoring by zenith sky visible spectrometry in Arctic and Antarctic N89-14577

**CENTRO BRASILEIRO DE PESQUISAS FISICAS, RIO DE JANEIRO.**
On the labeling and symmetry adaptation of the solvable finite groups representations [DE88-703954] N89-14812

**CERAMATEC, INC., SALT LAKE CITY, UT.**
Development of a microcircuit grid technique for automated crack length measurement for fatigue testing at elevated temperature [AD-A198003] N89-14463

**CERAMIC PROCESS SYSTEMS CORP., CAMBRIDGE, MA.**
Composite ceramic superconducting filaments for superconducting cable [AD-A198657] N89-14888

**CHICAGO UNIV., IL.**
Molecular beam studies of surface phonons and gas surface interactions [AD-A198435] N89-14826
Cosmic dust collection with a sub satellite tethered to a Space Station N89-15010

**CHRISTOPHER NEWPORT COLL., NEWPORT NEWS, VA.**
Effects of electron irradiation on high temperature superconductors and contacts to high temperature superconductors N89-14900

**CITY UNIV. OF NEW YORK, STATEN ISLAND.**
Resident database interfaces to the DAVID system, a heterogeneous distributed database management system [NASA-CR-184615] N89-14946

**CLARKSON UNIV., POTSDAM, NY.**
Constitutive relations for rapidly sheared granular flows: A Monte Carlo form based on the kinetic theory of dense gases N89-14387
Theoretical study of polar and global ozone changes using a coupled radiative-dynamical 2-D model N89-14590

**CLEMSON UNIV., SC.**
Polygons, stars, and clusters: An investigation of polygon displays [AD-A198430] N89-14719

**COLLEGE OF WILLIAM AND MARY, WILLIAMSBURG, VA.**
Optimization of slender wings for center-of-pressure shift due to change in Mach number N89-14897
Radiation effects on polymeric materials N89-14914
The effects of atomic oxygen on polymeric materials N89-14921

Generalized Eigenvalues for pairs on heritian matrices
N89-14923

**COLORADO STATE UNIV., FORT COLLINS.**
Circuit behavior in the development of neuronal networks
| AD-A198040 | N89-14672
Semiconducting transition metal silicides: New materials for optoelectronics on silicon
| AD-A198139 | N89-14881

**COLORADO UNIV., BOULDER.**
New absolute gravity instruments for physics and geophysics N89-14404
The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
Measurements of NO and total reactive odd-nitrogen, NOy, in the Antarctic stratosphere N89-14555
Airborne measurements of tropospheric ozone destruction and particulate bromide formation in the Arctic N89-14582
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product
N89-14601
Cloud classification from satellite data using a fuzzy sets algorithm: A polar example
| NASA-CR-184568 | N89-14708
Proceedings of the Air Force Workshop on Artificial Intelligence Applications for Integrated Diagnostics
| AD-A192453 | N89-14740
Artificial intelligence technology for the maintainer's associate N89-14752
Artificial intelligence in test program development
N89-14769
Self-adaptive databases
| AD-A197883 | N89-14944

**COLUMBIA UNIV., NEW YORK, NY.**
Spontaneous and induced coherent radiation generated in atomic vapor
| AD-A198060 | N89-14282
Electron-beam-pumped semiconductor lasers
N89-14425

**COMBUSTION ENGINEERING, INC., WINDSOR, CT.**
GDS: An intelligent diagnostic software shell
N89-14766

**COMMUNICATIONS SATELLITE CORP., CLARKSBURG, MD.**
Assessment of satellite communications quality study. Addendum 1: Impact of propagation delay on data transmission
| NASA-CR-182229 | N89-14369

**COMPUTER SCIENCES CORP., FALLS CHURCH, VA.**
STU-3 system level description and network applications, revision
| AD-A198514 | N89-14363

**CONNECTICUT UNIV., STORRS.**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
| AD-A197472 | N89-14668

**CORNELL UNIV., NEW YORK, NY.**
Bonding at metal-ceramic interfaces in hybrid materials
| AD-A197928 | N89-14261

**COUNCIL FOR NATIONAL ACADEMIC AWARDS (ENGLAND).**
An investigation into fluid film lubrication in dynamically loaded bearings N89-14442

## D

**DAVID SARNOFF RESEARCH CENTER, PRINCETON, NJ.**
High-power AlGaAs channeled substrate planar diode lasers for spaceborne communications
| NASA-CR-4189 | N89-14426

**DAYTON UNIV., OH.**
Dynamic combustion studies using advanced optical diagnostics. Volume 2: Tabulated data
| AD-A198025 | N89-14281

**DENVER UNIV., CO.**
Infrared measurements in the spring 1987 ozone hole
N89-14547

**DEPARTMENT OF ENERGY, WASHINGTON, DC.**
Summaries of the FY88 applied mathematical sciences research program
| DE89-000242 | N89-14784
Research and technology utilization
| DE88-016749 | N89-14996

**DEPARTMENT OF ENERGY, MINES, AND RESOURCES, OTTAWA (ONTARIO).**
Impact experimentation and the microgravity environment: An overview N89-15016

**DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, LAUDER (NEW ZEALAND).**
Stratospheric column NO2 measurements from three Antarctic sites N89-14542

**DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, OBERPFAFFENHOFEN (WEST GERMANY).**
Turbulence structure of Arctic stratus clouds derived from measurements and simulations
| DFVLR-FB-88-29 | N89-14633
A software package for sequential quadratic programming
| DFVLR-FB-28-28 | N89-14731

**DIRECTION DES RECHERCHES ETUDES ET TECHNIQUES, PARIS (FRANCE).**
Study of the discrete models of the Boltzmann equation
| DRET-86-1507/DS/SR | N89-14797

**DURHAM UNIV. (ENGLAND).**
CCD polarimetry as a probe of regions of recent star-formation N89-15054

**DYNAMICS RESEARCH CORP., FAIRBORN, OH.**
Processor and data bus interface analyses
| AD-A198801 | N89-14696

## E

**EARTH SATELLITE CORP., CHEVY CHASE, MD.**
Remote sensing technologies and spatial data applications
| AD-A195809 | N89-14480

**ECOLE DES MINES, PARIS (FRANCE).**
Fatigue evolution of small two and three dimensional cracks under variable and constant amplitude loading
| MM-AL/AP-04-88 | N89-14471

**EDGERTON, GERMESHAUSEN AND GRIER, INC., IDAHO FALLS, ID.**
The use of think aloud verbal protocols for the identification of mental models
| DE88-015180 | N89-14935

**EDINBURGH UNIV. (SCOTLAND).**
Multi-object astronomical spectroscopy with optical fibres N89-15048

**ELIZABETH CITY STATE UNIV., NC.**
The determination of energy transfer rates in the Ho:Tm:Cr:YAG laser material N89-14915

**ELORET CORP., SUNNYVALE, CA.**
Simulation studies for surfaces and materials strength
| NASA-CR-183378 | N89-14824

**ENVIRONMENTAL PROTECTION AGENCY, CORVALLIS, OR.**
Analysis of crop loss for alternative ozone exposure indices
| PB88-214788 | N89-14608

**ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC.**
Assessing the risks of trace gases that can modify the stratosphere. Volume 1: Executive summary
| PB88-231055 | N89-14610
Assessing the risks of trace gases that can modify the stratosphere. Volume 6: Technical support documentation production projections
| PB88-231071 | N89-14611
Assessing the risks of trace gases that can modify the stratosphere. Volume 7: Technical support documentation atmospheric science papers
| PB88-231089 | N89-14612
Assessing the risks of trace gases that can modify the stratosphere. Volume 8: Technical support documentation ozone depletion and plants
| PB88-231097 | N89-14613

**ENVIRONMENTAL RESEARCH LAB., DULUTH, MN.**
Simplifying complex QSAR's (Quantitative Structure-Activity Relationships) in toxicity studies with multivariate statistics
| PB88-233937 | N89-14614

**EUREKA COLL., IL.**
Laser clocks and near field gravity of rotating objects
N89-14911

**EUROPEAN SPACE AGENCY, PARIS (FRANCE).**
Touchstone for success: The Materials and Process Laboratories
| ESA-BR-52 | N89-14244
ESA's activities report
| ISSN-0258-025X | N89-14937

## F

**FEDERAL AVIATION ADMINISTRATION, WASHINGTON, DC.**
A microcomputer pollution model for civilian airports and air force bases, model description
| AD-A199003 | N89-14616

**FERMI NATIONAL ACCELERATOR LAB., BATAVIA, IL.**
High performance parallel computers for science: New developments at the Fermilab Advanced Computer Program
| DE88-016465 | N89-14733

**FLORIDA UNIV., GAINESVILLE.**
Development of laser-excited molecular luminescence spectrometric methods for aromatic hydrocarbons
| DE88-017305 | N89-14276
Implantation studies of hydrogen by field ion microscopy and spectroscopy
| DE88-016020 | N89-14293

**FMC CORP., SANTA CLARA, CA.**
A generic architecture for knowledge-based equipment fault diagnosis N89-14767
System integration of knowledge-based maintenance aids N89-14768

**FOERSVARETS FORSKINGSANSTALT, STOCKHOLM (SWEDEN).**
Current induced by HEMP (High-Altitude Electromagnetic Pulse) on wire above ground
| PB88-212048 | N89-14353

**FOM-INST. VOOR PLASMAFYSICA, RIJNHUIZEN, JUTPHAAS (NETHERLANDS).**
Activities report in plasma physics
| ETN-89-93377 | N89-14864

**FORD AEROSPACE AND COMMUNICATIONS CORP., SUNNYVALE, CA.**
Beyond rules: The next generation of expert systems
N89-14759

**FORD MOTOR CO., DEARBORN, MI.**
ETX-I: First-generation single-shaft electric propulsion system program. Volume 2: Battery
| DE89-000079 | N89-14378

**FOREST SERVICE, WASHINGTON, DC.**
Space shuttle large format camera photography cloud cover interference diagrams
| PB88-244405 | N89-14482

**FOSTER-MILLER ASSOCIATES, INC., WALTHAM, MA.**
Automated fatigue crack growth measurement
| AD-A198642 | N89-14466

**FRAUNHOFER INST. FUER WERKSTOFFMECHANIK, FREIBURG (GERMANY, F.R.).**
Fracture behaviour under impact 2
| AD-A198643 | N89-14467

**FRONTIER TIMBER CO., BRADFORD, PA.**
Transient magnetohydrodynamic liquid-metal flows in a rectangular channel with a moving conducting wall
| AD-A197308 | N89-14841

**FUSION POWER ASSOCIATES, GAITHERSBURG, MD.**
Commercial objectives, technology transfer, and systems analysis for fusion power development
N89-14851

## G

**GAS RESEARCH INST., CHICAGO, IL.**
Ceramics: Materials for severe environments
| PB88-240049 | N89-14308

**GENERAL ATOMIC CO., SAN DIEGO, CA.**
Toroidal pinch experiments in OHTE with a resistive shell
| DE88-017339 | N89-14858

**GEOLOGICAL SURVEY, FLAGSTAFF, AZ.**
Mapping experiment with space station N89-15046

**GEORGE WASHINGTON UNIV., WASHINGTON, DC.**
Response of composite plates subjected to acoustic loading
| NASA-CR-184618 | N89-14469

**GEORGIA INST. OF TECH., ATLANTA.**
Cyclic deformation, damage, and effects of environment in the Ni3Al ordered alloy at elevated temperatures
| AD-A198500 | N89-14300
Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements
| AD-A198656 | N89-14367
Analysis of shell-type structures subjected to time-dependent mechanical and thermal loading
| NASA-CR-183005 | N89-14457

**GOULD, INC., ROLLING MEADOWS, IL.**
Incorporating design for test into an IC design expert system N89-14746

**GTE LABS., INC., WALTHAM, MA.**
Transport and junction physics of semiconductor-metal eutectic composites
| AD-A198480 | N89-14884

**GUELPH UNIV. (ONTARIO).**
The initiation of grain movement by wind N89-15029

## H

**HAMPTON INST., VA.**
An example of a harmonizable process whose spectral domain is not complete
| NASA-CR-184653 | N89-14800
NASA/American Society for Engineering Education (ASEE) Summer Faculty Fellowship Program 1988
| NASA-CR-181724 | N89-14896

Modifying PASVART to solve singular nonlinear 2-point boundary problems N89-14906
Curriculum in aerospace science and technology in cooperation with NASA Langley Research Center N89-14908
Evaluation of the pseudo pilot effect on baseline controller study data N89-14920

**HARRIS CORP., SYOSSET, NY.**
The integrated diagnostic support system N89-14745

**HARRY DIAMOND LABS., ADELPHI, MD.**
Preparation, structure, and spectroscopic properties of nd(3+): (La(1-x)Lu(x)) 3(Lu(1-y)Ga(y)) 2(Ga)3 O12 crystals
[AD-A198476] N89-14883

**HARVARD UNIV., CAMBRIDGE, MA.**
Light weight high performance manipulators
[AD-A198647] N89-14448
In situ observations of BrO over Antarctica: ER-2 aircraft results from 54 S to 72 S latitude N89-14583
The chemistry of Antarctic ozone 1960-1987 N89-14604
Josephson junction arrays with positional disorder: Experiments and simulations N89-14867
Linear clusters of galaxies N89-15050

**HAWAII UNIV., HONOLULU.**
A concatenated coded modulation scheme for error control (addition 2)
[NASA-CR-183260] N89-14706
The nature of luminous IRAS galaxies N89-15053

**HELSINKI UNIV. OF TECHNOLOGY, ESPOO (FINLAND).**
Combining signals of widely differing bit rates on fiber optic subscriber lines
[PB88-210067] N89-14352

**HELSINKI UNIV. TECHNOLOGY, OTANIEMI (FINLAND).**
Flux vector splitting of the one-dimensional Euler equations
[PB88-210109] N89-14214

**HITCO, GARDENA, CA.**
Statistical characterization of carbon phenolic prepreg materials, volume 1
[NASA-CR-179416] N89-14306

**HONEYWELL, INC., NEW HOPE, MN.**
Mechanical reliability of piezoelectric and dielectric ceramics
[AD-A198458] N89-14327

**HUGHES RESEARCH LABS., MALIBU, CA.**
Ionization rates relevant to laser cooling of hydrogen
[AD-A198481] N89-14440
Mechanisms of radiation damage generated by ionizing radiation in optical waveguides
[AD-A198030] N89-14834

## I

**IIT RESEARCH INST., CHICAGO, IL.**
ELF (Extremely Low Frequency) communication system ecological monitoring program: Electromagnetic field measurements and engineering support, 1987
[AD-A198303] N89-14360

**ILLINOIS INST. OF TECH., CHICAGO.**
Equipment to upgrade the facilities of the IIT (Illinois Institute of Technology) Fluid Dynamics Research Center
[AD-A198084] N89-14242

**ILLINOIS UNIV., CHICAGO.**
Study of extreme ultraviolet laser sources for the guiding of particle beams
[DE88-008918] N89-14435

**ILLINOIS UNIV., URBANA.**
Numerical methods to solve the problem of scattering from electrically large bodies
[AD-A198098] N89-14359
Thermal analysis system (DSC, TGA, TMA) for oxidation and phase transformation studies of alloys with mestable phase
[AD-A198420] N89-14415
Fault-tolerant distributed algorithms for agreement and ifiection
[AD-A198416] N89-14718
Parallel processing techniques for the simulation of MOS VLSI circuits using waveform relaxation
[AD-A197879] N89-14734
Approximation methods for the consistent initialization of differential-algebraic equations
[DE88-017316] N89-14781
Computational methods and software for differential equations and their applications
[DE89-000025] N89-14783
Status of fusion research and implications for D/He-3 systems N89-14845
Acoustic phonon scattering in modulation doped Aluminum (subx) Gallium (sub 1x) Arsenide/Gallium arsenide heterojunctions
[AD-A198512] N89-14885

**INDIANA UNIV., BLOOMINGTON.**
A new method for trace metal determinations by monitoring modulated magnetically induced optical rotation in atomic vapours
[AD-A198799] N89-14272
Detection of ions by replacement-ion chromatography coupled to a microwave-induced nitrogen discharge at atmospheric pressure
[AD-A198800] N89-14273

**INSTITUTE FOR PERCEPTION RVO-TNO, SOESTERBERG (NETHERLANDS).**
Workload for air combat and air traffic controllers
[IZF-1987-32] N89-14230
Sound attenuation and speech transmission quality of five types of headsets
[IZF-1987-23] N89-14373
Working in impermeable clothing: Criteria for maximum stress
[IZF-1987-24] N89-14692
Description of the RSG-10 noise data base
[IZF-1988-03] N89-14945

**INSTITUTE OF GAS TECHNOLOGY, CHICAGO, IL.**
Advanced concepts for contaminant resistant fuel cells
[DE88-017151] N89-14496

**INSTITUUT TNO VOOR WERKTUIGKUNDIGE CONSTRUCTIES, DELFT (NETHERLANDS).**
Description of the network method and the simulation package simulation based on networks (SIMONE)
[IWECO-5176814-87-1] N89-14730

**INTERFEROMETRICS, INC., VIENNA, VA.**
NAVSPASUR system performance analysis
[AD-A198848] N89-14252

**INTERNATIONAL BUSINESS MACHINES CORP., SAN JOSE, CA.**
Block interrupt polysilane derivatives
[AD-A198804] N89-14312
Radiation sensitivity of soluble polysilane derivatives: Science and applications
[AD-A198805] N89-14313

**INTERNATIONAL SOFTWARE SYSTEMS, INC., AUSTIN, TX.**
RADC (Rome Air Development Center) system/software requirements engineering testbed research and development program
[AD-A197858] N89-14711

**IOWA STATE UNIV. OF SCIENCE AND TECHNOLOGY, AMES.**
Sediment-transport experiments in zero-gravity N89-15020

**IOWA UNIV., IOWA CITY.**
Design sensitivity analysis and optimization of nonlinear structures: A unified approach
[PB88-235171] N89-14458

**ITT DEFENSE COMMUNICATIONS DIV., SAN DIEGO, CA.**
Automatic speaker recognition system
[AD-A197980] N89-14358

## J

**JACKSON STATE UNIV., MS.MS.**
End-effector - joint conjugates for robotic assembly of large truss structures in space: A second generation N89-14898

**JAPAN ATOMIC ENERGY RESEARCH INST., TOKYO.**
A general expression of Jacobian matrix and its simplified computation method: Relationships between the velocities of manipulator hand and joints
[DE88-754808] N89-14782

**JET PROPULSION LAB., CALIFORNIA INST. OF TECH., PASADENA.**
Multicolor pyrometer for materials processing in space, phase 2
[NASA-CR-183358] N89-14406
Magnetic and electric field meters developed for the US Department of Energy
[NASA-CR-184628] N89-14421
Laboratory studies of sticking coefficients and heterogeneous reactions important in the stratosphere N89-14539
Infrared aircraft measurements of stratospheric composition over Antarctica during September 1987 N89-14546
An FTIR spectrometer for remote measurements of atmospheric composition N89-14550
Observational results of microwave temperature profile measurements from the airborne Antarctic ozone experiment N89-14558
Simulation of the transport of halogen species from the equatorial and mid-latitude stratosphere to the polar stratosphere in a two-dimensional model N89-14595
Chemistry of chlorinated species in the Antarctic stratosphere N89-14598
Studies of ClO and BrO reactions important in the polar stratosphere: Kinetics and mechanism of the ClO + BrO and ClO + ClO reactions N89-14599
Chemistry of the CO dimer at low temperatures N89-14602
High resolution FTIR spectroscopy of the ClO radical N89-14607
Low-gravity facilities for Space Station planetology experiments N89-15032
How to make a comet N89-15035

**JOHANN-WOLFGANG-GOETHE-UNIV., FRANKFURT AM MAIN (GERMANY, F.R.).**
Scientific evaluation and assessment of ASL developed moist atmosphere models for low stratus subclouds
[AD-A198762] N89-14625

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Cryogenic thermometers based on TVO type resistors and their application
[DE88-703755] N89-14413
Adaptable pulsed analog-to-digital converter
[DE88-703778] N89-14701
Analogs of Clifford algebra for forms above quadratic and their matrix realization
[DE88-703748] N89-14787
Finite-difference methods for solution of the many-dimensional nonlinear Schroedinger equation
[DE88-703772] N89-14788
Numerical schemes in the stabilization method for nonlinear differential equations of second order
[DE88-703773] N89-14789
Superconformal algebras in two dimensions
[DE88-703786] N89-14790
Estimation of parameters and the goodness-of-fit test for multivariate distributions for data presented as one-dimensional histograms
[DE88-703697] N89-14803
Study of the localized vibrations of the hydrogen in solid solution Zr-O by inelastic neutron scattering
[DE88-702945] N89-14866
Modified soldered joints of current-carrying superconductors
[DE88-703754] N89-14878
On a solution of the Einstein gravitation equation for dust matter
[DE88-703739] N89-14893
Modelling of central density spectra of extensive air showers from primary particles with E = 10(sup 2)-10(sup 7) GeV
[DE88-703728] N89-15069

**JOINT PUBLICATIONS RESEARCH SERVICE, ARLINGTON, VA.**
JPRS report: Science and technology. USSR: Life sciences
[JPRS-ULS-87-008] N89-14658
Effects of calcitonin and retabolil on rat femur in hypokinesia N89-14659
Holographic recording of deformation waves in muscle tissue N89-14660
Influence of high temperature on total gas metabolism of animals with limitation of motor activity N89-14661
Influence of emotional-pain stress on contractile function of myocardium during long-term hypokinesia N89-14662
Correction of acute hypoxia-induced changes in blood coagulation in rabbits N89-14663
Functional significance and mechanisms of variability in baroreceptor reflex N89-14664
Systemic hemodynamic shifts in hypoxia N89-14665

## K

**KANSAS STATE UNIV., MANHATTAN.**
The influence of grazing on land surface climatological variables
[NASA-CR-183308] N89-14637

**KANSAS UNIV. CENTER FOR RESEARCH, INC., LAWRENCE.**
Investigation of radar backscattering from second-year sea ice
[NASA-CR-180986] N89-14479

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[PB88-204060] N89-14678
Robustness of marginal maximum likelihood estimation in the Rasch model
[PB88-209374] N89-14801

**KERNFORSCHUNGSANLAGE, JUELICH (GERMANY, F.R.).**
Observations of stratospheric source gas profiles during the Arctic winter N89-14573

**KESTREL DEVELOPMENT CORP., PALO ALTO, CA.**
Synthesis of graphical displays for tabular data
[AD-A198979] N89-14707
**KEURING VAN ELECTROTECHNISCHE MATERIALEN N.V., ARNHEM (NETHERLANDS).**
Application of inductively coupled plasma atomic emission spectroscopy analysis with a polychromator/monochromator combination the byproducts of coal-fired power stations
[PB88-226535] N89-14838
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Radiative aspects of Antarctic ozone hole in 1985
N89-14592

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**LAWRENCE LIVERMORE NATIONAL LAB., CA.**
Ultra-high velocity, HE-driven projectile launchers
[DE88-015429] N89-14246
Anelastic and thermal properties of ethylene/acrylic acid copolymers partially ionized with transition metals
[DE88-017006] N89-14316
A synthetic route to organic aerogels: Mechanism, structure, and properties
[DE88-017112] N89-14317
Electromagnetic penetration through finite-length narrow slots in planar conducting screens
[DE88-016046] N89-14370
Application of Fabry-Perot velocimeter to high-speed experiments
[DE88-016269] N89-14410
High-Speed Microphotographic Laboratory
[DE88-017009] N89-14411
Study of extreme ultraviolet laser sources for the guiding of particle beams
[DE88-008918] N89-14435
The electron laser facility: A millimeter wave free-electron laser amplifier
[DE88-016118] N89-14436
Dynamics of structures: Solution techniques
[DE88-017022] N89-14461
Dynamics of structures: Fundamentals
[DE88-017027] N89-14462
Parallel heterogeneous mesh refinement for advective-diffusive equations
[DE88-017026] N89-14786
Use of laser diodes for analog fiber optic diagnostics systems
[DE88-017012] N89-14833
Photonic applications of thin film GaAs grown on silicon and insulating substrates by molecular beam epitaxy
[DE88-016975] N89-14877
Interactive access to scientific and technological factual databases worldwide
[DE88-016172] N89-14943
Experimental cosmochemistry in the Space Station
N89-15002
Electrical conductivity of carbonaceous chondrites and electric heating of meteorite parent bodies N89-15011
Electrical conductivity of chondritic meteorites
N89-15012
Gamma rays from Cygnus X-1: New diagnostics for a black hole
[DE88-016275] N89-15067
A hard X-ray spectrometer for high angular resolution observations of cosmic sources
[DE88-017005] N89-15068
**LIMOGES UNIV. (FRANCE).**
Multilayer plasma coats used as thermal barrier in engines
[ETN-89-93598] N89-14333
**LOCKHEED ENGINEERING AND MANAGEMENT SERVICES CO., INC., LAS VEGAS, NV.**
Determination of pH by flow injection analysis and by fiber optrode analysis
[PB88-235502] N89-14270
**LOCKHEED MISSILES AND SPACE CO., HUNTSVILLE, AL.**
Development of the general interpolants method for the CYBER 200 series of supercomputers
[NASA-CR-4183] N89-14704
**LOCKHEED MISSILES AND SPACE CO., PALO ALTO, CA.**
The computational structural mechanics testbed architecture. Volume 1: The language
[NASA-CR-178384] N89-14472
Application developer's tutorial for the CSM testbed architecture
[NASA-CR-181732] N89-14473
The CSM testbed matrix processors internal logic and dataflow descriptions
[NASA-CR-181742] N89-14474
Knowledge-based analysis of telemetry data on the Hubble space telescope N89-14751
On-board expert diagnostics for an avionics subsystem N89-14758
**LOGISTICS MANAGEMENT INST., BETHESDA, MD.**
The nature of the aircraft component failure process: A working note
[AD-A197979] N89-14234
**LOS ALAMOS NATIONAL LAB., NM.**
Chemical and Laser Sciences Division
[DE88-017140] N89-14274
Composite foams
[DE89-000368] N89-14315
Electromagnetic time-domain calculations in two and three dimensions
[DE89-000311] N89-14355
Transverse effects of a waveguide coupling slot
[DE89-000340] N89-14356
Dynamics of unbound vortices in the 2-dimensional XY and anisotropic Heisenberg models
[DE89-000371] N89-14394
Subpicosecond, high-brightness excimer laser systems
[DE88-016239] N89-14430
Experiments with three identical ultraprecision machine tools
[DE88-016324] N89-14445
The birth of the second generation: The Hitachi S-820/80
[DE88-014439] N89-14697
Mass storage system reference model system management
[DE88-016325] N89-14698
The JNC-16: A 16-channel data acquisition and analysis module
[DE88-017200] N89-14699
Design and implementation of a supercomputer frame buffer system
[DE88-007834] N89-14703
A direct iterative-variational method for solving large sets of linear algebraic equations
[DE88-016149] N89-14780
Green's function Monte Carlo calculations of 4He
[DE89-000379] N89-14802
High-power microwave source development at Los Alamos
[DE89-000327] N89-14830
Nuclear reactor power as applied to a space-based radar mission
[NASA-TM-101200] N89-14831
Radiation-induced transient absorption in single mode optical fibers
[DE89-000392] N89-14832
The physics of the high density Z-pinch
[DE88-016147] N89-14855
Edge-plasmas and wall protection in RFPs (Reversed-Field Pinch)
[DE89-000386] N89-14860
Technology and physics implications of oscillating-field current drive in reversed-field pinches
[DE89-000388] N89-14861
Falling antimatter: An experiment to measure the gravitational acceleration of the antiproton
[DE89-000313] N89-14892
The Baksan Neutrino Observatory Soviet-American Gallium Solar Neutrino Experiment
[DE89-000375] N89-15061
**LOUISIANA STATE UNIV., BATON ROUGE.**
The Baksan Neutrino Observatory Soviet-American Gallium Solar Neutrino Experiment
[DE89-000375] N89-15061
**LOWELL UNIV., MA.**
Some test/analysis issues for the space station structural characterization experiment N89-14901
**LOYOLA UNIV., CHICAGO, IL.**
Information processing of complex sounds in the anteroventral cochlear nucleus
[AD-A198576] N89-14673

## M

**MAGNAVOX ELECTRONIC SYSTEMS CO., FORT WAYNE, IN.**
MEND: "A self-improving" diagnostic with deep knowledge N89-14764
**MANCHESTER UNIV. (ENGLAND).**
Field tests and experiments on visibility modification
[AD-A197956] N89-14643
**MANHATTAN COLL., NEW YORK.**
Statistical model of environmental contaminants using variance spectrum analysis
[PB88-235130] N89-14615
**MARTIN MARIETTA AEROSPACE, NEW ORLEANS, LA.**
Liquid Rocket Booster (LRB) for the Space Transportation System (STS) systems study. Study plan
[NASA-CR-179401] N89-14249
**MARYLAND UNIV., COLLEGE PARK.**
Calculation of the steadily periodic and gust responses of a hingeless rotor helicopter using two-dimensional time domain unsteady aerodynamics N89-14240
Investigation of RF excited CW CO2 waveguide lasers local oscillator - RF excitation
[NASA-CR-183344] N89-14427
Determining conductivity by boundary measurements: Some numerical results
[AD-A198014] N89-14792
Macromolecular calculations in the XTAL system of crystallographic programs
[AD-A198525] N89-14886
Analysis of ISEE-3/ICE solar wind data
[NASA-CR-184652] N89-15063
**MASSACHUSETTS INST. OF TECH., CAMBRIDGE.**
Condensation polymers with controlled structure
[AD-A198086] N89-14321
Solid state research
[NASA-CR-183328] N89-14342
Monolithic two-dimensional surface-emitting arrays of GaAs/AlGaAs diode lasers N89-14343
Synchronously pumped mode-locked Ti:Al2O3 lasers
N89-14344
Residual infrared absorption in Ti:Al2O3 crystals
N89-14345
New MBE buffer for micron- and quarter-micron-gateGaAs MESFETs N89-14346
RF surface resistance of YBa2Cu3O(7-x) thin films
N89-14347
Design of feedback control systems for unstable plants with saturating actuators
[NASA-CR-183392] N89-14377
The effect of transmission design on force-controlled manipulator performance
[AD-A198131] N89-14689
Composing data and process descriptions in the design of software systems
[AD-A198096] N89-14714
Pattern-directed invocation with changing equalities
[AD-A198146] N89-14715
Generating tests by exploiting designed behavior
N89-14741
Optical inference machines
[AD-A197880] N89-14772
Computation of algebraic polynomial parametric surface intersections
[PB88-208277] N89-14778
Experimental studies of crystal-melt differentiation in planetary basalt compositions N89-15018
Kinetics of mineral condensation in the solar nebula
N89-15019
**MAX-PLANCK-INST. FUER CHEMIE, MAINZ (GERMANY, F.R.).**
Modelling the Antarctic ozone hole N89-14605
**MAX-PLANCK-INST. FUER KERNPHYSIK, HEIDELBERG (GERMANY, F.R.).**
Rocket- and aircraft-borne trace gas measurements in the winter polar stratosphere N89-14574
**MCDONNELL AIRCRAFT CO., ST. LOUIS, MO.**
Avionics fault tree analysis and artificial intelligence for future aircraft maintenance N89-14760
**MELBOURNE UNIV., PARKVILLE (AUSTRALIA).**
Climatology of the Melbourne University general circulation model
[PB88-227491] N89-14638
**METEOROLOGICAL OFFICE, BRACKNELL (ENGLAND).**
Photochemical trajectory modelling studies of the 1987 Antarctic spring vortex N89-14559
Diagnostic studies of the 1987 Antarctic spring vortex
N89-14587
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Total ozone by lunar Dobson observation at Syowa, Antarctica N89-14504
**MIAMI UNIV., CORAL GABLES, FL.**
Semi-prognostic tests of cumulus parameterization schemes in the middle latitudes
[PB88-236013] N89-14639
Heat flow and magnetization in the oceanic lithosphere
[NASA-CR-183346] N89-14853
**MICHIGAN UNIV., ANN ARBOR.**
Underexpanded noncondensing turbulent gas jets in liquids
[AD-A197939] N89-14396
Determination of soil moisture beneath a stalk or trunk dominated canopy
[NASA-CR-183322] N89-14621

Investigations of the dynamics and thermodynamics of the mesosphere and upper thermosphere at the polar regions
[AD-A198463] N89-14627
The language distribution of bibliographic records in selected online databases N89-14940

**MIDWEST RESEARCH INST., GOLDEN, CO.**
US photovoltaic patents, 1951--1987
[DE88-001178] N89-14497

**MILLITECH CORP., SOUTH DEERFIELD, MA.**
Quantitative observations of the behavior of anomalous low altitude ClO in the Antarctic spring Stratosphere, 1987 N89-14548
Daytime ClO over McMurdo in September 1987: Altitude profile retrieval accuracy N89-14549

**MINNESOTA UNIV., MINNEAPOLIS.**
Two-equation low-Reynolds-number turbulence modeling of transitional boundary layer flows characteristic of gas turbine blades N89-14218
Coupled three-dimensional conduction and natural convection heat transfer N89-14388
Laboratory studies of HNO3/H2O mixtures at low temperatures N89-14533
Studies of the interstellar medium in the inner galaxy at 21 centimeters N89-15055

**MISSISSIPPI STATE UNIV., MISSISSIPPI STATE.**
Spacelab system analysis: A study of communications systems for advanced launch systems
[NASA-CR-183515] N89-14248
Spacelab system analysis: A study of the Marshall Avionics System Testbed (MAST)
[NASA-CR-183516] N89-14354
Overlapping grids for flow field calculations N89-14918

**MISSOURI UNIV., ROLLA.**
Modeling of hydrogen-air diffusion flame N89-14913

**MISSOURI UNIV., ST. LOUIS.**
Fundamental quantum 1/F noise in ultrasmall semiconductor devices and their optimal design principles
[AD-A198462] N89-14381

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The effects of biomass burning on the concentration of trace gases in the atmosphere N89-14904

## N

**NAGOYA UNIV. (JAPAN).**
Decending motion of particle and its effect on ozone hole chemistry N89-14570

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[PB88-223870] N89-14477
Mathematical sciences: Some research trends
[PB88-232798] N89-14779

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, DC.**
Current achievements in cosmonautics
[NASA-TT-20365] N89-14245
Electrochemical synthesis of barium cuprate
[NASA-TT-20327] N89-14271
NASA geodynamics program summary report, 1979-1987 progress and future outlook
[NASA-TM-4065] N89-14476
Summary of along-track data from the earth radiation budget satellite for several representative ocean regions
[NASA-RP-1206] N89-14634
Aerospace medicine and biology: A continuing bibliography with indexes
[NASA-SP-7011(318)] N89-14675
Living in space
[EP-222] N89-14684
Numbering of new elements for net refinement
[NASA-TT-20435] N89-14737
Diamond chemical vapor deposition apparatus
[NASA-TT-20380] N89-14870
Social sciences and space exploration
[EP-192] N89-14895
Program solicitation closing date: July 22, 1988
[NASA-TM-101217] N89-14934
Report on OTHER proposals for SSPEX N89-15003
Exobiology experiment concepts for Space Station N89-15017
Ultraviolet spectroscopy of meteoric debris: In situ calibration experiments from earth orbit N89-15031

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CA.**
Two-dimensional aerodynamic characteristics of the OLS/TAAT airfoil
[NASA-TM-89435] N89-14216
Laser Doppler velocimeter multiplexer interface for simultaneous measured events
[NASA-CASE-ARC-11536-1] N89-14384
Correlation of N2O and ozone in the Southern Polar vortex during the airborne Antarctic ozone experiment N89-14520
Comparison of in situ aerosol measurements with SAGE 2 and SAM 2 aerosol measurements during the airborne Antarctic ozone experiment N89-14522
Antarctic polar stratospheric aerosols: The roles of nitrates, chlorides and sulfates N89-14527
On the size and composition of particles in polar stratospheric clouds N89-14528
Ice in the Antarctic polar stratosphere N89-14530
In-situ measurements of total reactive nitrogen, total water vapor, and aerosols in polar stratospheric clouds in the Antarctic stratosphere N89-14531
Heterogeneous physicochemistry of the winter polar stratosphere N89-14535
Physical processes in polar stratospheric ice clouds N89-14536
Observations of condensation nuclei in the 1987 airborne Antarctic ozone experiment N89-14541
Measurements of ozone in the Antarctic region during August and September of 1987 N89-14552
In situ observations of ClO in the Antarctic: Evidence for chlorine catalyzed destruction of ozone N89-14554
Measurements of NO and total reactive odd-nitrogen, NOy, in the Antarctic stratosphere N89-14555
Mixing ratios of trace gases in the austral polar atmosphere during August and September of 1987 N89-14556
Southern Hemispheric nitrous oxide measurements obtained during 1987 airborne Antarctic ozone experiment N89-14557
Temperature and horizontal wind measurements on the ER-2 aircraft during the 1987 airborne Antarctic ozone experiment N89-14560
Trace gas measurements from whole air samples collected over the Antarctic continent N89-14561
The meteorological measurement system on the NASA ER-2 aircraft N89-14562
Dehydration in the lower Antarctic stratosphere in late winter and spring N89-14564
Temporal trends and transport within and around the Antarctic polar vortex during the formation of the 1987 Antarctic ozone hole N89-14565
Small scale structure and mixing at the edge of the Antarctic vortex N89-14566
Transport into the south polar vortex in early spring N89-14567
In situ observations of ClO in the wintertime Northern Hemisphere: ER-2 aircraft results from 21 N to 61 N latitude N89-14575
Analysis of FDDI synchronous traffic delays
[NASA-CR-183223] N89-14695
Evolution of photon and particle spectra in compact, luminous objects
[NASA-TM-101247] N89-14825
Welcome to Ames Research Center (1987 forum on Federal technology transfer)
[NASA-TM-100088] N89-14995
Physics of windblown particles N89-15000
Particle formation and interaction N89-15001
Scientific results of the NASA-sponsored study project on Mars: Evolution of its climate and atmosphere
[NASA-TM-101207] N89-15059

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD INST. FOR SPACE STUDIES, NEW YORK, NY.**
Global impact of the Antarctic ozone hole: Simulations with a 3-D chemical transport model N89-14586

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.**
Legislated emergency locating transmitters and emergency position indicating radio beacons
[NASA-CASE-GSC-12892-1] N89-14374
Polar Ozone Workshop. Abstracts
[NASA-CP-10014] N89-14503
Total ozone changes in the 1987 Antarctic ozone hole N89-14505
The breakup of the Southern Hemisphere spring polar ozone and temperature minimums from 1979 to 1987 N89-14506
The threee-dimensional morphology of the Antarctic ozone hole N89-14509
Estimation of errors in the TOMS total ozone measurement during the Antarctica ozone campaign of August/September 1987 N89-14510
Seasonal and temporal changes in the vertical profiles of polar stratospheric ozone: 1978-1986 N89-14513
The morphology and meteorology of Southern Hemisphere spring total ozone mini-holes N89-14516
Ozone profiles above Palmer Station, Antarctica N89-14518
Large-scale variations in ozone and polar stratospheric clouds measured with airborne lidar during formation of the 1987 ozone hole over Antarctica N89-14525
The evolution of AAOE observed constituents with the polar vortex N89-14568
Variations of total ozone in the north polar region as seen by TOMS N89-14571
The QBO and interannual variation in total ozone N89-14584
Comparison of the poleward transport of ozone in the Northern and Southern Hemispheres N89-14591
User's guide for the Nimbus 7 Scanning Multichannel Microwave Radiometer (SMMR) CELL-ALL tape
[NASA-RP-1210] N89-14648
A study for systematic errors of the GLA forecast model in tropical regions
[NASA-TM-101194] N89-14651
Nucleation and particle coagulation experiments in microgravity N89-15030
Volatilization-fractionation of silicates related to chondrite composition N89-15036

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. HUGH L. DRYDEN FLIGHT RESEARCH FACILITY, EDWARDS, CA.**
Development and use of interactive displays in real-time ground support research facilities
[NASA-TM-101694] N89-14683

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. JOHN F. KENNEDY SPACE CENTER, COCOA BEACH, FL.**
Sensor-based diagnosis using knowledge of structure and function N89-14770

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TX.**
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
[NASA-TM-100459-VOL-1] N89-14331
Atomic oxygen effects measurements for shuttle missions STS-8 and 41-G
[NASA-TM-100459-VOL-2] N89-14332
Bio-reactor cell culture process
[NASA-CASE-MSC-21293-1] N89-14666
Eye and head motion during head turns in spaceflight
[NASA-TM-100466] N89-14676
Studies of the horizontal vestibulo-ocular reflex on STS 7 and 8
[NASA-TM-100468] N89-14677
Iodine sorption study on the proposed use of Viton A in a shuttle galley water accumulator
[NASA-TM-100467] N89-14691
Space shuttle food system summary, 1981-1986
[NASA-TM-100469] N89-14693
Lunar hydrogen: A resource for future use at lunar bases and space activities N89-14847
Experiments in Planetary and Related Sciences and the Space Station
[NASA-CP-2494] N89-14998
Planetary impact experimentation N89-14999
An overview of the program to place advanced automation and robotics on the Space Station N89-15004
Impact cratering in reduced-gravity environments: Early experiments on the NASA KC-135 aircraft N89-15008
Low-gravity impact experiments: Progress toward a facility definition N89-15009
Dynamic crystallization experiments on chondrule melts in reduced gravity N89-15023
Kinetics in a turbulent nebular cloud N89-15025
A system for conducting igneous petrology experiments under controlled redox conditions in reduced gravity N89-15040

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, HAMPTON, VA.**
Thrust-reverser flow investigation on a twin-engine transport
[NASA-TP-2856] N89-14213
Investigation of a moving-model technique for measuring ground effect
[NASA-TM-4080] N89-14217
High lift, low pitching moment airfoils
[NASA-CASE-LAR-13215-1] N89-14224
Passive venting technique for shallow cavities
[NASA-CASE-LAR-14031-1] N89-14232
Passive venting technique for shallow cavities
[NASA-CASE-LAR-13875-1] N89-14233
The 13-inch magnetic suspension and balance system wind tunnel
[NASA-TM-4090] N89-14241
Method of insetting predesigned disbond areas into composite laminates
[NASA-CASE-LAR-13225-1] N89-14258
Materials and structures for hypersonic vehicles
[NASA-TM-101501] N89-14264
Polyphenylquinoxalines containing alkylenedioxy groups
[NASA-CASE-LAR-13601-1-CU] N89-14337

Frequency domain laser velocimeter signal processor
[NASA-CASE-LAR-13552-1-CU] N89-14385
Effect of heat release on the spatial stability of a supersonic reacting mixing layer
[NASA-CR-181753] N89-14402
Ultrasonic depth gauge for liquids under high pressure
[NASA-CASE-LAR-13300-1-CU] N89-14407
Circumferential pressure probe
[NASA-CASE-LAR-13775-1] N89-14408
Pressure measuring probe
[NASA-CASE-LAR-13853-1] N89-14423
Method and apparatus for reducing speckle
[NASA-CASE-LAR-13771-1] N89-14428
IMAT (Integrated Multidisciplinary Analysis Tool) user's guide for the VAX/VMS computer
[NASA-TM-101500] N89-14475
Antarctic measurements of ozone, water vapor, and aerosol extinction by Sage 2 in the spring of 1987 N89-14508
Dynamics Explorer 1 SOI images of the Antarctic ozone hole N89-14515
Persistence of Antarctic polar stratospheric clouds N89-14521
Extinction and backscatter measurements of Antarctic PSC's, 1987: Implications for particle and vapor removal N89-14532
Research conducted at the Institute for Computer Applications in Science and Engineering in applied mathematics, numerical analysis and computer science
[NASA-CR-181757] N89-14694
On Hilbert-Schmidt norm convergence of Galerkin approximation for operator Riccati equations
[NASA-CR-181755] N89-14798
Single-grid spectral collocation for the Navier-Stokes equations
[NASA-CR-181754] N89-14799
LARCMACS: A TEX macro set for typesetting NASA reports
[NASA-TM-101522] N89-14994
Preliminary estimates of galactic cosmic ray shielding requirements for manned interplanetary missions
[NASA-TM-101516] N89-15070

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND, OH.**

Numerical analysis of flow through oscillating cascade sections
[NASA-TM-101417] N89-14220
Advanced core technology: Key to subsonic propulsion benefits
[NASA-TM-101420] N89-14237
Simulation of 3-D viscous flow within a multi-stage turbine
[NASA-TM-101376] N89-14238
Plotting component maps in the Navy/NASA Engine Program (NNEP): A method and its usage
[NASA-TM-101433] N89-14239
Power systems facility
[NASA-TM-101447] N89-14247
Leakage predictions for Rayleigh-step, helium-purge seals
[NASA-TM-101352] N89-14255
Graphite fluoride fiber polymer composite material
[NASA-CASE-LEW-14472-1] N89-14259
Oxidation behavior of FeAl + Hf,Zr,B
[NASA-TM-101402] N89-14297
Castable hot corrosion resistant alloy
[NASA-CASE-LEW-14134-2] N89-14303
Stability of bulk Ba2YCu3O(7-x) in a variety of environments
[NASA-TM-101401] N89-14310
Some composite bearing and seal materials for gas turbine applications: A review
[NASA-TM-101451] N89-14338
Effects of crucible wetting during solidification of immiscible Pb-Zn
[NASA-TM-101372] N89-14341
Liquid sheet radiator apparatus
[NASA-CASE-LEW-14295-1] N89-14348
Experimental results for a two-dimensional supersonic inlet used as a thrust deflecting nozzle
[NASA-TM-83439] N89-14386
Effects of core turbulence on jet excitability
[NASA-TM-101405] N89-14403
Automated data acquisition and processing for a Hohlraum reflectometer
[NASA-TM-101393] N89-14416
Heat flux measurements
[NASA-TM-101428] N89-14418
Improvement in finite element meshes: Heat transfer in an infinite cylinder
[NASA-TM-101410] N89-14450
The role of thermal and lubricant boundary layers in the transient thermal analysis of spur gears
[NASA-TM-101435] N89-14452
Tooth contact shift in loaded spiral bevel gears o, IL, 25-27 Apr. 1989; sposored by ASME
[NASA-TM-101438] N89-14453
Parametric studies of advanced turboprops
[NASA-TM-101389] N89-14465
A review of failure models for unidirectional ceramic matrix composites under monotonic loads
[NASA-TM-101421] N89-14470
Universal limiter for transient interpolation modeling of the advective transport equations: The ULTIMATE conservative difference scheme
[NASA-TM-100916] N89-14794
Nuclear reactor power as applied to a space-based radar mission
[NASA-TM-101200] N89-14831
Lunar Helium-3 and Fusion Power
[NASA-CP-10018] N89-14842
Assessment of lunar sources of He-3 for use on earth N89-14853
Microgravity research in NASA ground-based facilities
[NASA-TM-101397] N89-15047

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, AL.**

Capillary heat transport and fluid management device
[NASA-CASE-MFS-28217-1] N89-14392

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. PASADENA OFFICE, CA.**

Joule Thomson refrigerator
[NASA-CASE-NPO-17143-1-CU] N89-14351
Controlled sample orientation and rotation in an acoustic levitator
[NASA-CASE-NPO-17086-1-CU] N89-14422

**NATIONAL ARCHIVES AND RECORDS SERVICE, WASHINGTON, DC.**

On 3480 class tape cartridge drives and archival data storage: Technology assessment report
[PB88-233135] N89-14939

**NATIONAL BUREAU OF STANDARDS, BOULDER, CO.**

Investigation of the hydrogen source for masers
[PB88-225685] N89-14424
Break junctions 1
[PB88-241849] N89-14869

**NATIONAL BUREAU OF STANDARDS, GAITHERSBURG, MD.**

Mechanical property enhancement in ceramic matrix composites
[PB88-232863] N89-14257
Center for Electronics and Electrical Engineering technical progress bulletin covering Center programs, October to December 1987 with 1988 CEEE events calendar
[PB88-232913] N89-14375
Working fluid selection for space-based two-phase heat transport systems
[NASA-CR-183324] N89-14390
Traceability of laser interferometric length measurements
[PB88-225677] N89-14405

**NATIONAL BUREAU OF STANDARDS, WASHINGTON, DC.**

Experiments with three identical ultraprecision machine tools
[DE88-016324] N89-14445

**NATIONAL CENTER FOR ATMOSPHERIC RESEARCH, BOULDER, CO.**

Observations of stratospheric temperature changes coincident with the recent Antarctic ozone depletions N89-14507
Filter measurements of chemical composition during the airborne Antarctic ozone experiment N89-14526
Infrared measurements of column amounts of stratospheric constituents in the Antarctic winter, 1987 N89-14545
Temporal and spatial distribution of stratospheric trace gases over Antarctica in August and September, 1987 N89-14551
Evolution of the Antarctic polar vortex in spring: Response of a GCM to a prescribed Antarctic ozone hole N89-14589
Retrieval of atmospheric temperatures and gas volume mixing ratios and column amounts from infrared solar absorption spectra
[PB88-236153] N89-14622
Semi-prognostic tests of cumulus parameterization schemes in the middle latitudes
[PB88-236013] N89-14639
Implicit normal-mode initialization of the PSU/NCAR (Pennsylvania State University/National Center for Atmospheric Research) mesoscale model
[PB88-126021] N89-14640

**NATIONAL CENTER FOR EARTHQUAKE ENGINEERING RESEARCH, BUFFALO, NY.**

Finite element formulation for nonlinear viscoplastic material using a Q-model
[PB88-213764] N89-14776

**NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BOULDER, CO.**

Seasonal and temporal changes in the vertical profiles of polar stratospheric ozone: 1978-1986 N89-14513
Total ozone, ozone vertical distributions, and stratospheric temperatures at South Pole, Antarctica, in 1986 and 1987 N89-14519
Ground-based measurements of O3, NO2, OClO, and BrO during the 1987 Antarctic ozone depletion event N89-14543
Near UV atmospheric absorption measurements from the DC-8 aircraft during the 1987 airborne Antarctic ozone experiment N89-14544
Observations of diurnal variations of BrO and OClO at McMurdo Station, Antarctica (78S) N89-14553
Synoptic and chemical evolution of the Antarctic vortex in winter and spring, 1987 N89-14563
Visible and near-ultraviolet spectroscopy at Thule AFB (76.5 N) from January 28 - February 15, 1988 N89-14576
Springtime surface ozone fluctuations at high Arctic latitudes and their possible relationship to atmospheric bromine N89-14581
Measurements of the ClO radical vibrational band intensity and the ClO + ClO + M reaction product N89-14601
TIROS/NOAA (television and infrared observation satellite/National Oceanic and Atmospheric Administration) satellites space environment monitor archive tape documentation, 1988 update
[PB88-224613] N89-14619
Small linear wind tunnel saltation experiments: Some experiences N89-15015

**NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, WASHINGTON, DC.**

NMC stratospheric analyses during the 1987 Antarctic expedition N89-14511

**NATIONAL PHYSICAL LAB., TEDDINGTON (ENGLAND).**

Analysis of hydrogen diffusion and trapping in a 13 percent chromium martensitic stainless steel
[NPL-DMA(A)-158] N89-14301
The precise determination of the refractive index of air
[NPL-MOM-90] N89-14629
VAMAS surface chemical analysis standard data transfer format with skeleton decoding programs
[NPL-DMA(A)-164] N89-14724
A national intercomparison of hydrophone calibration methods
[NPL-AC-116] N89-14819
An intercomparison of the radium mass standards of the UK and the USSR
[NPL-RS(EXT)-103] N89-14828

**NATIONAL SECURITY INDUSTRIAL ASSOCIATION, WASHINGTON, DC.**

Guidelines for preparation of diagnostic requirements N89-14765

**NATIONAL WEATHER SERVICE, GARDEN CITY, NY.**

AEX: Automatic program execution
[PB88-231121] N89-14705

**NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY, BAY ST. LOUIS, MS.**

The role of horizontal processes in upper-ocean prediction: A forecast simulation in the Sea of Japan
[AD-A198827] N89-14654
Chemical variability in ocean frontal areas
[AD-A198418] N89-14655

**NAVAL OCEAN SYSTEMS CENTER, SAN DIEGO, CA.**

Geolocation via satellite: A methodology and error analysis
[AD-A197955] N89-14253

**NAVAL POSTGRADUATE SCHOOL, MONTEREY, CA.**

Data acquisition and control for multiple composite life tests
[AD-A198395] N89-14263
Finite element electromagnetic scattering: An interactive micro-computer algorithm
[AD-A198552] N89-14364
Dynamic stall computations using a zonal Navier-Stokes model
[AD-A197942] N89-14397
An advanced study of natural convection immersion cooling of a 3 x 3 array of simulated components in an enclosure filled with dielectric liquid
[AD-A197962] N89-14398
Semiconductor laser diodes and the design of a D.C. powered laser diode drive unit
[AD-A198556] N89-14441
A study of a rapid cyclogenesis event during gale
[AD-A198555] N89-14645
Mental models for time displayed tasks
[AD-A198536] N89-14682
CD-ROM (Compact Disc Read Only Memory) library of the future
[AD-A197943] N89-14702
A split-Levinson approach to autoregressive modeling
[AD-A198535] N89-14722

Evaluation of work distribution algorithms and hardware topologies in a multi-transputer network
| AD-A198530 | N89-14736
B-spline-Bezier representation of tau-splines
| AD-A197937 | N89-14791

**NAVAL RESEARCH LAB., WASHINGTON, DC.**
Adsorption of chlorine on clean and on oxygen pre-exposed Al(3)
| AD-A198005 | N89-14260
The effect of high heating rate on the pyrolysis of polymeric and composite materials
| AD-A198052 | N89-14319
Automatic detection, tracking and sensor integration
| AD-A198347 | N89-14361
Momentum flux increases and coherent-structure dynamics in a subsonic axisymmetric free jet
| AD-A198360 | N89-14399
HANEX simulations of laser-target interactions: 1. Radiation processes
| AD-A197965 | N89-14438
Stochastic electron detrapping in FELs (Free Electron Lasers) caused by sidebands
| AD-A198361 | N89-14439

**NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, BETHESDA, MD.**
Analysis of ductile-brittle transition temperatures for controlled-rolled, microalloyed, C-Mn-based steels
| AD-A198132 | N89-14298
Transient magnetohydrodynamic liquid-metal flows in a rectangular channel with a moving conducting wall
| AD-A197308 | N89-14841

**NAVAL SURFACE WEAPONS CENTER, SILVER SPRING, MD.**
Synthesis of energetic single phase and multi-phase polymers
| AD-A198431 | N89-14325

**NAVY CENTER FOR APPLIED RESEARCH IN ARTIFICIAL INTELLIGENCE, WASHINGTON, DC.**
The FIS electronics troubleshooting system N89-14742

**NEW MEXICO STATE UNIV., UNIVERSITY PARK.**
A study of environmental influences on the structure of spiral galaxy disks N89-15051

**NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA).**
Electrochemical studies of molten glass N89-14266
Measurement and prediction of mass transfer in solid catalysts N89-14267
Studies of metal beta-diketonates by reversed-phase high performance liquid chromatography N89-14268
Gas chromatographic and spectroscopic studies of cobalt(II) and other selected transition metal chelates of tetradentate beta-ketoenamines N89-14269
The development of iron-aluminium based alloys for aqueous corrosion resistance N89-14291
Heat exchanger optimization N89-14391
An inquiry into panic and its differentiation from other types of anxiety N89-14679
Nuclear spin cooling using antiferromagnetic magnons N89-14822
Methods of analysis of coupled spin-lattice relaxations and spin diffusion in heterogeneous organic solids with application to keratin N89-14823
Laser generated large amplitude longitudinal fields in inhomogeneous plasma with second harmonic super density resonances and quasi-uniform coronal oscillations N89-14840

**NEW YORK UNIV., NEW YORK.**
Perceptual factors in workload: A neuromagnetic study
| AD-A198487 | N89-14681

**NORFOLK STATE COLL., VA.**
Comparative study of career development and training programs N89-14927

**NORTH CAROLINA STATE UNIV., RALEIGH.**
Analysis of transport mechanisms in dense fuel droplet sprays
| DE88-017256 | N89-14393
The role of thermoelastic effects in the scuffing failure of rolling/sliding EHD contacts
| AD-A198475 | N89-14447

**NORTH CAROLINA UNIV., CHAPEL HILL.**
On exceedance point processes for stationary sequences under mild oscillation restrictions
| AD-A198314 | N89-14806
Nonparametric estimation of optimal performance criteria in quality engineering
| AD-A198315 | N89-14807
Base rate effects on the interpretation of probability and frequency expressions
| AD-A198456 | N89-14808

**NORTH TEXAS STATE UNIV., DENTON.**
Synthesis of new polynitropolyhedranes
| AD-A198320 | N89-14323
Polysilylated unsaturated molecules
| AD-A198492 | N89-14328

**NORTHWESTERN UNIV., EVANSTON, ILL.**
Cosmic dust collection with a sub satellite tethered to a Space Station N89-15010

## O

**OAK RIDGE NATIONAL LAB., TENN.**
Creep behavior of an Al2O3-SiC composite
| DE88-014553 | N89-14260
Two-bar thermal ratchetting of annealed 2.25Cr-1Mo steel N89-14304
Basic studies of gases for fast switches
| AD-A198641 | N89-14383
Influence of the A.C. Stark effect on stimulated hyper-Raman profiles in sodium vapor
| DE88-015557 | N89-14429
Design of an obstacle avoidance system for AIMS
| DE88-016783 | N89-14446
Introduction of the Proceedings of the Tenth Symposium on Biotechnology for Fuels and Chemicals
| DE88-016361 | N89-14667
Man-robot symbiosis: A framework for cooperative intelligence and control
| DE89-000430 | N89-14687
Generation of an ordered simple random sample without replacement using one random number
| DE89-001341 | N89-14785
Low activation materials for fusion
| DE88-015561 | N89-14854
Panel on high beta and/or high field tokamaks and stellarators
| DE88-017367 | N89-14859

**OAO CORP., GREENBELT, MD.**
PROMIS (Procurement Management Information System)
| NASA-CR-179395 | N89-14933

**OFFICE OF TECHNOLOGY ASSESSMENT, WASHINGTON, D.C.**
SDI (Strategic Defense Initiative): Technology, survivability and software
| PB88-236245 | N89-14811
Starpower: The US and the international quest for fusion energy, contractor documents
| PB88-214663 | N89-14839

**OHIO STATE UNIV., COLUMBUS.**
A user's manual for the Loaded Microstrip Antenna Code (LMAC)
| NASA-CR-184596 | N89-14725
Numerical methods for turbulent flow N89-14928
The influence of and the identification of nonlinearity in flexible structures N89-14932

**OHIO UNIV., ATHENS.**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
| AD-A197472 | N89-14668

**OKLAHOMA UNIV., NORMAN.**
The poststall nonlinear dynamics and control of an F-18: A preliminary investigation N89-14922

**OLD DOMINION UNIV., NORFOLK, VA.**
Navier-Stokes calculations of transonic flows past cavities
| NASA-CR-4210 | N89-14401
Effect of heat release on the spatial stability of a supersonic reacting mixing layer
| NASA-CR-181753 | N89-14402
Pretreatment of CO oxidation catalysts N89-14930

**OREGON GRADUATE CENTER FOR STUDY AND RESEARCH, BEAVERTON.**
Determination of optical properties by inversion of multiple scattering data: Experimental program
| AD-A198518 | N89-14837

**OREGON UNIV., EUGENE.**
Powerful photogenerated reducing agents
| AD-A197949 | N89-14279

**OSLO UNIV. (NORWAY).**
Zone measurements during wintertime in the Arctic. Comparision with recent measurements at the same places are made. Here the 30 hPa Temperatures are shown N89-14580

**OXFORD UNIV. (ENGLAND).**
Phase transformation and enhanced nuclear resonance in acoustics N89-14816
Stellar masses and laboratory astrophysics N89-15056

## P

**PACIFIC NORTHWEST LABS., RICHLAND, WASH.**
Fiber-optic spectrochemical emission sensors
| DE88-017175 | N89-14275
Vibration spectra of silica near 2400 K: Measurement and molecular dynamics simulation
| DE88-015925 | N89-14314
The data collection component of the Hanford Meteorology Monitoring Program
| DE89-000404 | N89-14641
Progress in lung modeling by the ICRP task group
| DE88-015934 | N89-14671

**PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.**
The synthesis and structure of polyphosphazenes
| AD-A198519 | N89-14329
The influence of porosity on short fatigue crack growth at large strain amplitudes
| AD-A198477 | N89-14464
Long term studies of the refractive index structure parameter in the troposphere and stratosphere
| AD-A198313 | N89-14626

**PENNSYLVANIA UNIV., PHILADELPHIA.**
The Baksan Neutrino Observatory Soviet-American Gallium Solar Neutrino Experiment
| DE89-000375 | N89-15061

**PERCEPTRONICS, INC., WOODLAND HILLS, CALIF.**
Decomposition strategies for eliciting expert knowledge: Judgements of dangerousness
| AD-A197913 | N89-14936

**PHYSICAL SCIENCES, INC., ANDOVER, MASS.**
Multicolor pyrometer for materials processing in space, phase 2
| NASA-CR-183358 | N89-14406

**PHYSICS AND ELECTRONICS LAB. TNO, THE HAGUE (NETHERLANDS).**
Radar Cross Section (RCS) reduction techniques for square trihedral corner reflectors at 35 GHz: Measurements and theoretical simulations
| FEL-1988-04 | N89-14365
Precision approach radars Twenthe and Volkel (Netherlands). Multipath propagation problems
| FEL-1988-15 | N89-14372
Specular reflection coefficient of snow at 10, 35 and 94 GHz as a function of grazing angle (Oberjettenberg-Campaign)
| FEL-1988-01 | N89-14495
Optical and infrared properties of the marine atmosphere, phase 1
| FEL-1987-76 | N89-14630

**PITTSBURGH UNIV., PA.**
Improved foundry castings utilizing CAD/CAM (Computer Aided Design/Computer Aided Manufacture). Volume 1: Overview
| AD-A198067 | N89-14712

**PLANNING RESEARCH CORP., HAMPTON, VA.**
Users' manual for the Langley high speed propeller noise prediction program (DFP-ATP)
| NASA-CR-4208 | N89-14820
Numerical simulation and comparison of symmetrical/supercritical airfoils for the near tip region of a helicopter in forward flight
| NASA-CR-4212 | N89-14821

**PRATT AND WHITNEY AIRCRAFT, EAST HARTFORD, CONN.**
Turbofan forced mixer lobe flow modeling. 1: Experimental and analytical assessment
| NASA-CR-4147-PT-1 | N89-14221
Turbofan forced mixer lobe flow modeling. 2: Three-dimensional inviscid mixer analysis (FLOMIX)
| NASA-CR-4147-PT-2 | N89-14222

**PRINCETON UNIV., N. J.**
Evolution of polar stratospheric clouds during the Antarctic winter N89-14534
The analysis of averages and the analysis of variance
| AD-A198467 | N89-14809
Sunset over Brownistan
| AD-A198443 | N89-14814
The Baksan Neutrino Observatory Soviet-American Gallium Solar Neutrino Experiment
| DE89-000375 | N89-15061

**PROUDMAN OCEANOGRAPHIC LAB., BIRKENHEAD (ENGLAND).**
Feasibility study for the development of a joint surge and wave model
| PB88-230917 | N89-14652

**PUERTO RICO UNIV., MAYAGUEZ.**
Transient heat transfer from shrinking LOX-drop N89-14916

**PURDUE UNIV., WEST LAFAYETTE, IND.**
Investigation of a new concept in semiconductor microwave oscillators
| AD-A198039 | N89-14380
Reactions of metal ions and their clusters in the gas phase using laser ionization-Fourier transform mass spectrometry
| DE88-017281 | N89-14431
Modeling of transitional flows N89-14917

## R


**RAYTHEON CO., BEDFORD, MASS.**
Expert systems in higher echelon maintenance activities N89-14761

**RENSSELAER POLYTECHNIC INST., TROY, N.Y.**
Analytical and experimental characterization of damage processes in composite laminates
[AD-A198068] N89-14262
Helium-3 blankets for tritium breeding in fusion reactors N89-14844
Crystal growth of CdTe in space and thermal field effects on mass flux and morphology
[NASA-CR-183263] N89-14868
Textural evolution of partially-molten planetary materials in microgravity N89-15037

**RESEARCH SOLUTIONS, INC., COLUMBUS, GA.**
Effects of low and high oxygen tensions and related respiratory conditions on visual performance: A literature review
[AD-A198688] N89-14669

**RICE UNIV., HOUSTON, TEX.**
The orbit properties of colliding co-orbiting bodies N89-15013
A magnetospheric simulation at the Space Station N89-15024

**RIJKSWATERSTAAT, RIJSWIJK (NETHERLANDS).**
Investigation and selection of an interactive graphics aid for the analysis and design phase. Report on the project ISOO-03
[AD-1987-1121] N89-14728

**RIJKSWATERSTAAT, THE HAGUE (NETHERLANDS).**
Exploration in the field of expert systems. Report on the project Expert 01
[AD-1987-1271] N89-14729

**ROBERTS ASSOCIATES, INC., VIENNA, VA.**
Analysis of electrophoresis performance
[NASA-CR-183508] N89-14265

**ROCHESTER UNIV., N. Y.**
Chirped pulse amplification: Present and future
[DE89-001016] N89-14434

**ROCKWELL INTERNATIONAL CORP., COLUMBUS, OHIO.**
Fabrication and testing of lightweight hydraulic system simulator hardware. Phase 2: Addendum
[AD-A198524] N89-14243

**ROCKWELL INTERNATIONAL CORP., THOUSAND OAKS, CALIF.**
Expert system on a chip: An engine for real-time approximate reasoning N89-14771

**ROME UNIV. (ITALY).**
Numerical optimization
[AD-A198586] N89-14793

**ROYAL NETHERLANDS METEOROLOGICAL INST., DE BILT.**
Automatic detection of inversions using sodar
[KNMI-TR-106] N89-14631
Geomagnetic survey of the Netherlands, reduced to 1985
[KNMI-TR-109] N89-14632
The measurement of gustiness at routine wind stations: A review
[KNMI-WR-87-11] N89-14646
Description of the Cabauw (Netherland) turbulence dataset 1977-1979
[KNMI-TR-105] N89-14647
Numerical atmospheric models
[KNMI-TR-107] N89-14649
Fitting of Meteosat information into meteorological decision making
[KNMI-TR-108] N89-14650
Energy dissipation of monochromatic sea waves in the turbulent boundary layer
[KNMI-TR-104] N89-14657

**RUTGERS - THE STATE UNIV., PISCATAWAY, N. J.**
On the use of 1-D finite elements for the temperature behavior of a contoured and partially plated SC-Cut resonator
[AD-A198309] N89-14882


## S


**SACLANT ASW RESEARCH CENTER, LA SPEZIA (ITALY).**
Make-map and MEDMAP: Two programs for plotting maps of the Mediterranean Sea
[AD-A198491] N89-14483
The numerical simulation of infrared satellite measurements over the Greenland-Iceland-Norwegian Sea
[AD-A198653] N89-14484
Qualitative aspects of seismograph/ocean bottom interaction
[AD-A198652] N89-14656

**SAINT ANDREW'S UNIV. (SCOTLAND).**
Nonlinear magnetic reconnection N89-15052

**SAN JOSE STATE UNIV., CALIF.**
New techniques for the detection and capture of micrometeoroids N89-15041

**SANDIA NATIONAL LABS., ALBUQUERQUE, N. MEX.**
A solar photochemical process for destroying organics in water
[DE89-000503] N89-14277
Monochromatic imaging studies of a low pressure arc burning on molten Inconel 718 alloy electrodes during vacuum arc remelting
[DE88-012855] N89-14292
Mechanical properties of dispersion strengthened copper: A comparison of braze cycle annealed and coarse grain microstructures
[DE89-001061] N89-14296
Transverter assembly for the advanced instrumentation radar
[DE89-001036] N89-14357
Impulse response of a frequency-dependent delay
[DE88-004793] N89-14368
Design of fault-tolerant circuits for photovoltaic concentrators
[DE89-001062] N89-14379
Use of time-resolved techniques for studying shock-induced vaporization
[DE88-017168] N89-14395
Development of strain gage evaluation channels
[DE88-017350] N89-14412
High-energy UV laser experiments
[DE89-000505] N89-14437
Shock response spectrum anomalies which occur due to imperfections in the data
[DE88-015846] N89-14459
Shaker shock testing using nonstationary random transients
[DE88-015847] N89-14460
Photovoltaics as an operating energy system
[DE88-017167] N89-14498
Measurement precautions for high-resistivity silicon solar cells
[DE89-000438] N89-14499
Crystalline silicon photovoltaic cell technology: Meeting the challenge for utility power
[DE89-000439] N89-14500
The effect of parasitic absorption losses on light trapping in thin silicon solar cells
[DE89-000457] N89-14501
The NC (Numerically Controlled) assistant: Interfacing knowledge based manufacturing tools to CAO/CAM systems
[DE88-016742] N89-14709
Progress toward inertial fusion with light ion beams at Sandia National Laboratories
[DE88-016693] N89-14862
Surface flashover threshold and switched fields of photoconductive semiconductor switches
[DE88-011618] N89-14876
Long-lived resonance states in Si-doped AlGaAs
[DE89-000305] N89-14879
GREEDI: The computerization of the DOE/DOD environmental data bank
[DE88-014965] N89-14941
DOE/DOD environmental data bank
[DE88-015262] N89-14942
Technology transfer: Transferring Federal R and D results for domestic commercial utilization
[DE89-000419] N89-14997

**SCHMITT (HARRISON H.), ALBUQUERQUE, NM.**
Economic geology of lunar Helium-3 N89-14849

**SCHWARTZ ELECTRO-OPTICS, INC., ORLANDO, FLA.**
Optical fiber data transfer system
[NASA-CR-181704] N89-14376

**SCIENCE RESEARCH COUNCIL, CHILTON (ENGLAND).**
A two-dimensional model of the quasi biennial oscillation of ozone N89-14596

**SEARCH TECHNOLOGY, INC., NORCROSS, GA.**
Development and demonstration of Microcomputer Intelligence for Technical Training (MITT)
[AD-A197971] N89-14775

**SENER S.A., MADRID (SPAIN).**
Transfer airlock requirements
[TAL-RP-SN-003] N89-14254

**SOCIETE NATIONALE DES POUDRES ET EXPLOSIFS, VERT-LE-PETIT (FRANCE).**
Characterization study of the structural bonding system EA 9680 (EA 9645). Test report 1/R/86
[REPT-1/R/86] N89-14334

**SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, RAPID CITY.**
Texture-based cloud classification N89-14931

**SOUTHEASTERN CENTER FOR ELECTRICAL ENGINEERING EDUCATION, INC., ST. CLOUD, FLA.**
Network management of highly adaptive communication networks
[AD-A198429] N89-14362

**SOUTHERN UNIV., BATON ROUGE, LA.**
Transportable educational programs for scientific and technical professionals: More effective utilization of automated scientific and technical data base systems
[NASA-CR-184507] N89-14947
USL/DBMS NASA/RECON working paper series. Standards
[NASA-CR-184508] N89-14948
Overview of the NASA/RECON educational, research, and development activities of the Computer Science Departments of the University of Southwestern Louisiana and Southern University
[NASA-CR-184509] N89-14949
NASA RECON: Course development, administration, and evaluation. A research and development proposal
[NASA-CR-184510] N89-14950
Transportable, university-level educational programs in interactive information storage and retrieval systems
[NASA-CR-184511] N89-14951
The man/machine interface in information retrieval: Providing access to the casual user
[NASA-CR-184512] N89-14952
Knowledge based systems: A preliminary survey of selected issues and techniques
[NASA-CR-184513] N89-14953
Concepts and implementations of natural language query systems
[NASA-CR-184514] N89-14954
A report on the USL NASA/RECON project. Part 1: The development of a transportable, university level, IS and R educational program
[NASA-CR-184515] N89-14955
A report on the USL NASA/RECON project. Part 2: PC-based R and D in support of IS and R applications
[NASA-CR-184516] N89-14956
Knowledge based systems: A critical survey of major concepts, issues, and techniques
[NASA-CR-184517] N89-14957
Knowledge based systems: A critical survey of major concepts, issues and techniques. Visuals
[NASA-CR-184518] N89-14958
An overview of selected information storage and retrieval issues in computerized document processing
[NASA-CR-184519] N89-14959
An innovative, multidisciplinary educational program in interactive information storage and retrieval
[NASA-CR-184520] N89-14960
An innovative, multidisciplinary educational program in interactive information storage and retrieval. Presentation visuals
[NASA-CR-184521] N89-14961
USL NASA/RECON project presentations at the 1985 ACM Computer Science Conference: Abstracts and visuals
[NASA-CR-184522] N89-14962
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems
[NASA-CR-184523] N89-14963
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems. Presentation visuals
[NASA-CR-184524] N89-14964
Natural language query system design for interactive information storage and retrieval systems
[NASA-CR-184525] N89-14965
Natural language query system design for interactive information storage and retrieval systems. Presentation visuals
[NASA-CR-184526] N89-14966
An hierarchical approach to performance evaluation of expert systems
[NASA-CR-184527] N89-14967
Some issues in data model mapping
[NASA-CR-184528] N89-14968
KARL: A Knowledge-Assisted Retrieval Language
[NASA-CR-184529] N89-14969
KARL: A Knowledge-Assisted Retrieval Language. Presentation visuals
[NASA-CR-184530] N89-14970
A survey of chemical information systems
[NASA-CR-184531] N89-14971
A methodology for the design and evaluation of user interfaces for interactive information systems
[NASA-CR-184532] N89-14972
An overview of the USL/DBMS NASA/PC R and D project working paper series
[NASA-CR-184533] N89-14973
The USL NASA PC R and D project: General specifications of objectives
[NASA-CR-184534] N89-14974

The USL NASA PC R and D development environment standards
[NASA-CR-184535] N89-14975
General specifications for the development of a PC-based simulator of the NASA RECON system
[NASA-CR-184536] N89-14976
General specifications for the development of a USL NASA PC R and D statistical analysis support package
[NASA-CR-184537] N89-14977
General specifications for the development of a USL/DBMS NASA/PC R and D distributed workstation
[NASA-CR-184538] N89-14978
The USL NASA PC R and D interactive presentation development system
[NASA-CR-184539] N89-14979
The USL NASA PC R and D project: Detailed specifications of objects
[NASA-CR-184540] N89-14980
Design criteria for a PC-based common user interface to remote information systems
[NASA-CR-184541] N89-14981
A performance evaluation of the IBM 370/XT personal computer
[NASA-CR-184542] N89-14982
USL/DBMS NASA/PC R and D project C programming standards
[NASA-CR-184543] N89-14983
USL/DBMS NASA/PC R and D project system design standards
[NASA-CR-184544] N89-14984
USL/DBMS NASA/PC R and D project system testing standards
[NASA-CR-184545] N89-14985
IBM PC/IX operating system evaluation plan
[NASA-CR-184546] N89-14986
PC-based Multiple Information System Interface (PC/MISI) design plan
[NASA-CR-184547] N89-14987
PC-based Multiple Information System Interface (PC/MISI) detailed design and implementation plan
[NASA-CR-184548] N89-14988
An overview of the evaluation plan for PC/MISI: PC-based Multiple Information System Interface
[NASA-CR-184549] N89-14989
NASA PC software evaluation project
[NASA-CR-184550] N89-14990
Object-oriented systems: An annotated bibliography
[NASA-CR-184551] N89-14991
A programming environment evaluation methodology for object-oriented systems
[NASA-CR-184552] N89-14992

**SOUTHWEST RESEARCH INST., SAN ANTONIO, TEX.**
Study of high temperature failure mechanisms in ceramics
[AD-A198375] N89-14324
The integrated diagnostic model: Towards a second generation diagnostic expert system N89-14747

**SRI INTERNATIONAL CORP., MENLO PARK, CALIF.**
Heterogeneous chemistry related to Antarctic ozone depletion: Reaction of ClONO2 and N2O5 on ice surfaces N89-14537
Lidar observations of polar stratospheric clouds at McMurdo, Antarctica, during NOZE-2 N89-14540

**STANFORD UNIV., CALIF.**
Transonic aeroelastic analysis of launch vehicle configurations
[NASA-CR-4186] N89-14215
A unified model for predicting the stress and strain distributions around cracks of any length, including elastic, plastic, creep and cyclic deformation N89-14455
Optical predetection processing for partially coherent systems N89-14815
Disk accretion onto weakly magnetized neutron stars N89-15057
An investigation of ground-based observations of solar oscillations at Stanford N89-15060
Magnetic properties of C 4 Doppler shift patterns
[AD-A198602] N89-15062

**STATE UNIV. OF NEW YORK, BROCKPORT.**
Use of the Terminal Area Simulation System (TASS) to study microburst wind shears N89-14899

**STATE UNIV. OF NEW YORK, BUFFALO.**
Development of BEM for ceramic composites
[NASA-CR-183313] N89-14311
Dynamics of observed reality: Abridged version of classical and quantum mechanics
[AD-A198637] N89-14894

**STATE UNIV. OF NEW YORK, STONY BROOK.**
Quantitative observations of the behavior of anomalous low altitude ClO in the Antarctic spring Stratosphere, 1987 N89-14548
Daytime ClO over McMurdo in September 1987: Altitude profile retrieval accuracy N89-14549
CO and IRAS FIR emission in interacting galaxies N89-15058
The circumstellar envelopes of young stellar objects and emission line stars N89-15066

**STRAINOPTIC TECHNOLOGIES, INC., NORTH WALES, PA.**
Digital image analysis system for monitoring crack growth at elevated temperature
[AD-A198649] N89-14468

**SUSSEX UNIV., BRIGHTON (ENGLAND).**
Identification of dynamic parameters of a squeeze-film bearing N89-14443

**SYRACUSE UNIV., N. Y.**
Northeast Artificial Intelligence Consortium annual report 1986. Volume 3: Distributed artificial intelligence for communication network management
[AD-A197957] N89-14774
Research Program in Elementary Particle Theory
[DE88-017241] N89-14891

**SYSTEMS APPLICATIONS, INC., SAN RAFAEL, CALIF.**
User's guide for executing OZIPM-4 (Ozone Isopleth Plotting with Optional Mechanisms, version 4) with CBM-4 (Carbon-Bond Mechanism-4)
[PB88-221965] N89-14609

**SYSTEMS TECHNOLOGY, INC., HAWTHORNE, CALIF.**
Autonomous RPRV navigation, guidance and control
[NASA-CR-179425] N89-14228

## T

**TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS).**
A walk along interfaces
[B8817008] N89-14223
Aspects of inertial investigation using a strapdown system
[ETN-89-93335] N89-14229
A fast ion beam pattern generator
[ETN-89-93354] N89-14350
Automation of a Guinier camera for X-ray diffraction
[ETN-89-93350] N89-14419
Quantitative holographic interferometry: Measurement of solid object deformations
[ETN-89-93351] N89-14420
On the connection of geodetic point fields in Reseau European Trigonometrique (RETRIG) and related tests for model errors
[ETN-89-93327] N89-14485
Precision of line following in digital images
[B8821610] N89-14486
On the connection of digitized maps to a uniform coordinate system. A special case of the geodetic connection problem
[B8821602] N89-14487
Homogeneous plate deformation as monitored by Satellite Laser Ranging (SLR) and analyzed using 3D affine transformation models
[B8821604] N89-14488
Variance components estimation in two dimensional geodetic networks
[ETN-89-93332] N89-14489
Automatic procedure to find corresponding points in CCD Airborne Experimental Scanner for Applications in Remote sensing (CAESAR) images
[B8821609] N89-14490
The use of short range stereophotogrammetry for facial asymmetry and growth studies; analysis and model
[B8821611] N89-14491
A study on least-squares prediction and collocation
[ETN-89-93336] N89-14492
Very Long Baseline Interferometry (VLBI): Relativity and geodesy
[ETN-89-93337] N89-14493
FRANK: Some aspects of the processing of observations using the interpretation instrument; measuring methods, instrumental errors and preprocessing of the observations
[ETN-89-93338] N89-14494
An asymptotic analysis of a class of nonlinear hyperbolic equations
[ETN-89-93352] N89-14796
Semigroups of operators, approximation and saturation in Banach spaces
[ETN-89-93353] N89-14813
Offset reduction and three dimensional field sensing with magnetotransistors
[ETN-89-93349] N89-14890
Data bases: Management of complex data structures using the semantic data model
[REPT-88-34] N89-14993

**TECHNISCHE HOGESCHOOL, EINDHOVEN (NETHERLANDS).**
Trace analysis by capillary gas chromatography: Theory and methods
[B8811770] N89-14289
Design of error control coding schemes for three problems of noisy information transmission, storage and processing
[B8811768] N89-14371
Numerical simulation of injection molding: Non-isothermal non-Newtonian flow of polymers in complex geometries
[ETN-89-93348] N89-14727
Queuing network models and performance analysis of computer systems
[B8811769] N89-14738
Collision phenomena in a quantum gas
[B8811778] N89-14829
Modeling of RF plasmas in a parallel plate etch reactor
[B8811775] N89-14865
A spectroscopic characterization of the structure of supported metal catalysts
[B8811777] N89-14889

**TECHNISCHE PHYSISCHE DIENST TNO-TH, DELFT (NETHERLANDS).**
Development of a contactless optoacoustic method for nondestructive testing. Part 2: Optical excitation of ultrasonic vibrations
[TPD-1987-0-2-PT-2] N89-14454

**TENNESSEE UNIV., KNOXVILLE.**
Basic studies of gases for fast switches
[AD-A198641] N89-14383
Semi-interpenetrating polymer network's of polyimides: Fracture toughness N89-14912

**TENNESSEE UNIV. SPACE INST., TULLAHOMA.**
A flight expert system (FLES) for on-board fault monitoring and diagnosis N89-14753

**TEXAS A&M UNIV., COLLEGE STATION.**
A unified approach to vehicle design, control, and flight path optimization N89-14231
Dynamic analysis of nonlinear rotor-housing systems
[NASA-CR-184611] N89-14449
A note on second order effects in a semiparametric context
[AD-A198018] N89-14804
A note on extended quasi-likelihood
[AD-A198042] N89-14805
Volatilization-devolatilization reactions N89-15014

**TEXAS TECHNOLOGICAL UNIV., LUBBOCK.**
The design and protocol of a summertime rainfall enhancement program for West Texas N89-14636

**TEXAS UNIV., AUSTIN.**
Simulation and analysis of a Geopotential Research Mission N89-14478

**TITAN SYSTEMS, INC., LA JOLLA, CALIF.**
Daylight and twilight sky radiance and terrestrial irradiance
[AD-A198550] N89-14628

**TOLEDO UNIV., OHIO.**
A numerical simulation of the full two-dimensional electrothermal de-icer pad
[NASA-CR-4194] N89-14235
A finite difference analysis of the heat transfer in periodic cavity flows N89-14389

**TOURS UNIV. (FRANCE).**
Cardiovascular system and space environment
[ETN-89-93600] N89-14674

## U

**ULTRASYSTEMS DEFENSE AND SPACE SYSTEMS, INC., IRVINE, CA.**
Boron-nitride preceramic polymer studies
[AD-A197359] N89-14309

**UNITED KINGDOM ATOMIC ENERGY AUTHORITY, HARWELL (ENGLAND).**
Stability and photochemistry of ClO dimers formed at low temperature in the gas phase N89-14600

**UNIVERSITE DE TECHNOLOGIE DE COMPIEGNE (FRANCE).**
System for the optimum design of structures
[ETN-89-93599] N89-14451

**UNIVERSITY OF SOUTH FLORIDA, TAMPA.**
A 3-D object recognition system using aspect graphs
[AD-A198472] N89-14720

**UNIVERSITY OF SOUTHERN CALIFORNIA, REDONDO BEACH.**
A generic expert diagnostician N89-14750

**UNIVERSITY OF SOUTHERN MISSISSIPPI, HATTIESBURG.**
Variable temperature solid state NMR of side-chain crystalline comb polymers
[AD-A198099] N89-14322

**UNIVERSITY OF SOUTHWESTERN LOUISIANA, LAFAYETTE.**
Transportable educational programs for scientific and technical professionals: More effective utilization of automated scientific and technical data base systems
[NASA-CR-184507] N89-14947

USL/DBMS NASA/RECON working paper series. Standards
[NASA-CR-184508] N89-14948
Overview of the NASA/RECON educational, research, and development activities of the Computer Science Departments of the University of Southwestern Louisiana and Southern University
[NASA-CR-184509] N89-14949
NASA RECON: Course development, administration, and evaluation. A research and development proposal
[NASA-CR-184510] N89-14950
Transportable, university-level educational programs in interactive information storage and retrieval systems
[NASA-CR-184511] N89-14951
The man/machine interface in information retrieval: Providing access to the casual user
[NASA-CR-184512] N89-14952
Knowledge based systems: A preliminary survey of selected issues and techniques
[NASA-CR-184513] N89-14953
Concepts and implementations of natural language query systems
[NASA-CR-184514] N89-14954
A report on the USL NASA/RECON project. Part 1: The development of a transportable, university level, IS and R educational program
[NASA-CR-184515] N89-14955
A report on the USL NASA/RECON project. Part 2: PC-based R and D in support of IS and R applications
[NASA-CR-184516] N89-14956
Knowledge based systems: A critical survey of major concepts, issues, and techniques
[NASA-CR-184517] N89-14957
Knowledge based systems: A critical survey of major concepts, issues and techniques. Visuals
[NASA-CR-184518] N89-14958
An overview of selected information storage and retrieval issues in computerized document processing
[NASA-CR-184519] N89-14959
An innovative, multidisciplinary educational program in interactive information storage and retrieval
[NASA-CR-184520] N89-14960
An innovative, multidisciplinary educational program in interactive information storage and retrieval. Presentation visuals
[NASA-CR-184521] N89-14961
USL NASA/RECON project presentations at the 1985 ACM Computer Science Conference: Abstracts and visuals
[NASA-CR-184522] N89-14962
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems
[NASA-CR-184523] N89-14963
The design of PC/MISI, a PC-based common user interface to remote information storage and retrieval systems. Presentation visuals
[NASA-CR-184524] N89-14964
Natural language query system design for interactive information storage and retrieval systems
[NASA-CR-184525] N89-14965
Natural language query system design for interactive information storage and retrieval systems. Presentation visuals
[NASA-CR-184526] N89-14966
An hierarchical approach to performance evaluation of expert systems
[NASA-CR-184527] N89-14967
Some issues in data model mapping
[NASA-CR-184528] N89-14968
KARL: A Knowledge-Assisted Retrieval Language
[NASA-CR-184529] N89-14969
KARL: A Knowledge-Assisted Retrieval Language. Presentation visuals
[NASA-CR-184530] N89-14970
A survey of chemical information systems
[NASA-CR-184531] N89-14971
A methodology for the design and evaluation of user interfaces for interactive information systems
[NASA-CR-184532] N89-14972
An overview of the USL/DBMS NASA/PC R and D project working paper series
[NASA-CR-184533] N89-14973
The USL NASA PC R and D project: General specifications of objectives
[NASA-CR-184534] N89-14974
The USL NASA PC R and D development environment standards
[NASA-CR-184535] N89-14975
General specifications for the development of a PC-based simulator of the NASA RECON system
[NASA-CR-184536] N89-14976
General specifications for the development of a USL NASA PC R and D statistical analysis support package
[NASA-CR-184537] N89-14977
General specifications for the development of a USL/DBMS NASA/PC R and D distributed workstation
[NASA-CR-184538] N89-14978
The USL NASA PC R and D interactive presentation development system
[NASA-CR-184539] N89-14979
The USL NASA PC R and D project: Detailed specifications of objects
[NASA-CR-184540] N89-14980
Design criteria for a PC-based common user interface to remote information systems
[NASA-CR-184541] N89-14981
A performance evaluation of the IBM 370/XT personal computer
[NASA-CR-184542] N89-14982
USL/DBMS NASA/PC R and D project C programming standards
[NASA-CR-184543] N89-14983
USL/DBMS NASA/PC R and D project system design standards
[NASA-CR-184544] N89-14984
USL/DBMS NASA/PC R and D project system testing standards
[NASA-CR-184545] N89-14985
IBM PC/IX operating system evaluation plan
[NASA-CR-184546] N89-14986
PC-based Multiple Information System Interface (PC/MISI) design plan
[NASA-CR-184547] N89-14987
PC-based Multiple Information System Interface (PC/MISI) detailed design and implementation plan
[NASA-CR-184548] N89-14988
An overview of the evaluation plan for PC/MISI: PC-based Multiple Information System Interface
[NASA-CR-184549] N89-14989
NASA PC software evaluation project
[NASA-CR-184550] N89-14990
Object-oriented systems: An annotated bibliography
[NASA-CR-184551] N89-14991
A programming environment evaluation methodology for object-oriented systems
[NASA-CR-184552] N89-14992

**US OLYMPIC COMMITTEE, COLORADO SPRINGS, CO.**
The effects of different run training programs on plasma responses of beta-endorphin, adrenocorticotropin and cortisol to maximal treadmill exercise
[AD-A197472] N89-14668

## V

**VALPARAISO UNIV., IND.**
An investigation of turbulence models N89-14905

**VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.**
Durability of adhesive joints: An engineering study
[PB88-233473] N89-14307
Polygons, stars, and clusters: An investigation of polygon displays
[AD-A198430] N89-14719
Control of the flexible modes of an advanced technology geostationary platform N89-14902
Extension and validation of a method for locating damaged members in large space trusses N89-14925

**VIRGINIA UNIV., CHARLOTTESVILLE.**
Random access algorithms for multiuser computer communication networks
[AD-A198090] N89-14713
Robust algorithms for detecting a change in a stochastic process with infinite memory
[AD-A198290] N89-14716

**VRIJE UNIV., AMSTERDAM (NETHERLANDS).**
Machine intelligence and explication
[PB88-204078] N89-14739
Connected part of the covariant Tate p-divisible group and the zeta-function of the family of hyperelliptic curves y sup 2 = 1 + mu(chi sup N) modulo various primes
[PB88-226659] N89-14777
Active information retrieval
[PB88-226642] N89-14938

## W

**WASHINGTON UNIV., SEATTLE.**
Investigations of the dynamics and thermodynamics of the mesosphere and upper thermosphere at the polar regions
[AD-A198463] N89-14627
Review projects for the US Fusion Program
[DE88-017306] N89-14856
High temperature blankets for non-electrical/electrical applications of fusion reactors
[DE88-017307] N89-14857
Approaches to non-linear aerodynamic analysis and design N89-14909



The viscoplastic behavior of SCS6/Ti-15-3 metal matrix composite materials at elevated temperatures N89-14929
Pair production and annihilation in gamma-ray bursts N89-15065

**WATERLOO UNIV. (ONTARIO).**
The surface enhanced raman scattering of the protonated forms of DABCO at a silver electrode
[AD-A197930] N89-14278

**WEAPONS SYSTEMS RESEARCH LAB., ADELAIDE (AUSTRALIA).**
Engines for Mini-RPV XM-1A
[AD-A198336] N89-14236

**WISCONSIN UNIV., MADISON.**
GHOST balloons around Antarctica N89-14517
Dynamical adjustments in the planetary boundary layer N89-14618
Large scale features of the atmospheric water vapor transport over the Amazon Region N89-14620
Classification and analysis of surface and clouds at high latitudes from AVHRR multispectral satellite data N89-14635
The moon: An abundant source of clean and safe fusion fuel for the 21st century N89-14843
Strategy for D/He-3 fusion development N89-14846
Processes and energy costs for mining lunar Helium-3 N89-14848
Mining for helium: Site selection and evaluation N89-14850

**WYOMING UNIV., LARAMIE.**
The UW digital ozonesonde: Characteristics and flow rate calibration N89-14512
Ozone profile measurements at McMurdo Station Antarctica during the spring of 1987 N89-14514
Stratosphere aerosol and cloud measurements at McMurdo Station Antarctica during the spring of 1987 N89-14523
Balloon borne Antarctic frost point measurements and their impact on polar stratospheric cloud theories N89-14524
Consideration of ionizing radiation shielding for optical fibers
[PB88-237029] N89-14817

## X

**XEROX PALO ALTO RESEARCH CENTER, CALIF.**
Reasoning about multiple faults N89-14743

## Y

**YALE UNIV., NEW HAVEN, CONN.**
The detection and study of molecular species using time resolved laser spectroscopy
[AD-A198482] N89-14285

### Typical Contract Number Index Listing

Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.


AF PROJ. 649L ..... N89-14342
AF PROJ. 2302 ..... N89-14262
AF PROJ. 2303 ..... N89-14279
N89-14323
N89-14326
N89-14328
AF PROJ. 2304 ..... N89-14716
N89-14720
N89-14814
AF PROJ. 2305 ..... N89-14380
N89-14381
N89-14835
AF PROJ. 2306 ..... N89-14261
N89-14300
AF PROJ. 2308 ..... N89-14284
AF PROJ. 2310 ..... N89-14626
N89-14627
AF PROJ. 2312 ..... N89-14672
AF PROJ. 2313 ..... N89-14673
AF PROJ. 2401 ..... N89-14735
AF PROJ. 2917 ..... N89-14286
N89-14415
N89-14723
AF-AFOSR-0022-87 ..... N89-14415
AF-AFOSR-0038-87 ..... N89-14242
AF-AFOSR-0044-87 ..... N89-14286
AF-AFOSR-0049-86 ..... N89-14626
AF-AFOSR-0050-87 ..... N89-14814
AF-AFOSR-0081-86 ..... N89-14279
AF-AFOSR-0085-84 ..... N89-14323
AF-AFOSR-0130-85 ..... N89-14381
AF-AFOSR-0147-85 ..... N89-14284
AF-AFOSR-0147-87 ..... N89-14672
AF-AFOSR-0162-87 ..... N89-14300
AF-AFOSR-0174-87 ..... N89-14627
AF-AFOSR-0193-85 ..... N89-14380
AF-AFOSR-0224-87 ..... N89-14716
AF-AFOSR-0244-83 ..... N89-14328
AF-AFOSR-0301-86 ..... N89-14772
AF-AFOSR-0316-86 ..... N89-14723
AF-AFOSR-0316-87 ..... N89-14720
AF-AFOSR-0321-86 ..... N89-14261
AF-AFOSR-0326-86 ..... N89-14673
AF-AFOSR-0366-84 ..... N89-14262
AF-AFOSR-0378-85 ..... N89-14835
ARPA ORDER 6214 ..... N89-14888
A78/KLU/049 ..... N89-14372
A79/K/106 ..... N89-14495
A79/KM/075 ..... N89-14630
A81/K/041 ..... N89-14692
A85/KLU/106 ..... N89-14454
A85/KLU/126 ..... N89-14365
A86/KLU/080 ..... N89-14230
A86/KM/103 ..... N89-14630
A86/KM/133 ..... N89-14730
A86/M/161 ..... N89-14373
A87/KL/064 ..... N89-14365
DA PROJ. F57-525 ..... N89-14719
DA PROJ. 1A8-DZ8-AANMTS ..... N89-14340
DA PROJ. 1L1-61102-AH-45 ..... N89-14453
DA PROJ. 1L1-61103-BH-57 ..... N39-14467
DA PROJ. 1L1-62209-A-47-A ..... N89-14452
DA PROJ. 2Q1-61102-B-74-F ..... N89-14808
N89-14936
DA-1L1-62209-A-47-A ..... N89-14450
DAAG29-84-C-0005 ..... N89-14834
DAAG29-84-K-0038 ..... N89-14837
DAAG29-85-K-0096 ..... N89-14448
DAAG29-85-K-0103 ..... N89-14285
DAAG29-85-K-0111 ..... N89-14329
DAAK30-78-C-0107 ..... N89-14712
DAAL03-86-C-0019 ..... N89-14880
DAAL03-86-D-0001 ..... N89-14669
DAAL03-86-K-0073 ..... N89-14809
DAAL03-87-K-0059 ..... N89-14367
DAAL03-87-K-0107 ..... N89-14882
DACW05-87-C-0012 ..... N89-14480
DAJA45-85-C-0047 ..... N89-14467
DAJA45-86-C-0001 ..... N89-14643
DAJA45-86-C-0028 ..... N89-14793
DAJA45-87-M-0333 ..... N89-14625
DASG60-80-C-0057 ..... N89-14762
DCA100-87-C-0013 ..... N89-14363
DE-AC02-76CH-00016 ..... N89-14409
DE-AC02-76CH-03000 ..... N89-14733
DE-AC02-76ER-03130 ..... N89-14732
DE-AC02-83CH-10093 ..... N89-14497
N89-14667
DE-AC03-76SF-00098 ..... N89-14409
N89-14874
N89-14875
DE-AC03-84ER-53158 ..... N89-14858
DE-AC04-76DP-00613 ..... N89-14349
DE-AC04-76DP-00789 ..... N89-14277
N89-14292
N89-14296
N89-14357
N89-14368
N89-14379
N89-14395
N89-14412
N89-14437
N89-14459
N89-14460
N89-14498
N89-14499
N89-14500
N89-14501
N89-14709
N89-14862
N89-14876
N89-14879
N89-14941
N89-14942
N89-14997
DE-AC05-84OR-21400 ..... N89-14260
N89-14304
N89-14383
N89-14429
N89-14446
N89-14667
N89-14686
N89-14687
N89-14785
N89-14854
N89-14859
DE-AC06-76RL-01830 ..... N89-14275
N89-14314
N89-14641
N89-14671
DE-AC07-76ID-01570 ..... N89-14935
DE-AC08-80CS-50101 ..... N89-14378
DE-AC21-86MC-23023 ..... N89-14496
DE-AS03-84ER-40136 ..... N89-14433
DE-AS06-78ET-52047 ..... N89-14856
N89-14857
DE-FC08-85DP-40200 ..... N89-14434
DE-FG02-85ER-40231 ..... N89-14891
DE-FG02-87ER-13766 ..... N89-14431
DE-FG02-87ER-25026 ..... N89-14781
N89-14783
DE-FG02-87ER-45285 ..... N89-14294
DE-FG03-86ER-53228 ..... N89-14858
DE-FG05-84ER-45172 ..... N89-14293
DE-FG05-87ER-13728 ..... N89-14393
DE-FG05-87ER-60501 ..... N89-14276
DI-14-08-0001-A-0468 ..... N89-14477
DRET-80-578 ..... N89-14451
DRET-82-355 ..... N89-14451
DRET-84-34-00-201-470-75-01 ..... N89-14333
DRET-85-136 ..... N89-14674
DRET-86-1507 ..... N89-14797
DRET-87-11-64 ..... N89-14471
EPA-68-02-4136 ..... N89-14609
EPA-68-03-3249 ..... N89-14270
ESTEC-7079/87-NL-PH(SC) ..... N89-14254
F08635-85-C-0122 ..... N89-14617
F19628-85-C-0002 ..... N89-14342
F30602-81-C-0193 ..... N89-14362
F30602-85-C-0008 ..... N89-14774
F30602-85-C-0129 ..... N89-14711
F33615-82-C-0013 ..... N89-14752
F33615-82-C-2255 ..... N89-14281
F33615-83-C-3603 ..... N89-14670
F33615-84-C-2431 ..... N89-14227
F33615-86-C-0530 ..... N89-14818
F33615-87-C-3233 ..... N89-14468
F33615-87-C-3236 ..... N89-14463
F33615-87-C-3240 ..... N89-14466
F41689-86-D-0052 ..... N89-14775
F49620-85-C-0073 ..... N89-14324
F49620-85-C-0140 ..... N89-14326
F49620-85-C-0144 ..... N89-14804
N89-14805
N89-14806
N89-14807
F49620-85-C-1040 ..... N89-14318
F49620-85-K-0004 ..... N89-14681
F49620-86-C-0034 ..... N89-14884
F49620-87-C-0037 ..... N89-14717
F49620-87-C-0083 ..... N89-14440
GRI-5086-234-1280 ..... N89-14444
MDA903-83-C-0198 ..... N89-14936
MDA903-83-K-0347 ..... N89-14808
MDA903-85-C-0139 ..... N89-14234
MIPR-ARO-136-87 ..... N89-14881
NAGW-455 ..... N89-14481
NAGW-976 ..... N89-14868
NAG1-158 ..... N89-14469
NAG1-513 ..... N89-14753
NAG1-768 ..... N89-14800
N89-14810
NAG2-297 ..... N89-14377
NAG2-304 ..... N89-14726
NAG2-433 ..... N89-14795
NAG3-55 ..... N89-14453
NAG3-72 ..... N89-14235
NAG3-534 ..... N89-14457
NAG3-888 ..... N89-14311
NAG5-263 ..... N89-14427
NAG5-355 ..... N89-14651
NAG5-414 ..... N89-14653
NAG5-480 ..... N89-14621
NAG5-579 ..... N89-15063
NAG5-763 ..... N89-14946
NAG5-842 ..... N89-14624
NAG5-864 ..... N89-14871
NAG5-897 ..... N89-14637
NAG5-898 ..... N89-14708
NAG5-931 ..... N89-14706
NAG8-686 ..... N89-14417
NASA ORDER C-99066-G ..... N89-14794
NASA ORDER W-16712 ..... N89-14479
NASW-3846 ..... N89-14947
N89-14948
N89-14949
N89-14950
N89-14951
N89-14952
N89-14953
N89-14954
N89-14955
N89-14956
N89-14957
N89-14958
N89-14959
N89-14960

NASW-4066 ..... N89-15059
NASW-4307 ..... N89-14245

NAS1-15783 ..... N89-14704
NAS1-17441 ..... N89-14426
NAS1-18000 ..... N89-14820

NAS1-18107 ..... N89-14402

NAS1-18331 ..... N89-14376
NAS1-18444 ..... N89-14472

NAS1-18605 ..... N89-14402

NAS3-23039 ..... N89-14221

NAS3-23772 ..... N89-14256
NAS3-23790 ..... N89-14369
NAS4-2896 ..... N89-14228
NAS5-29386 ..... N89-14648
NAS7-1002 ..... N89-14406
NAS8-35926 ..... N89-14933
NAS8-36042 ..... N89-14265
NAS8-36293 ..... N89-14449
NAS8-36298 ..... N89-14306
NAS8-36413 ..... N89-14251
NAS8-36717 ..... N89-14248

NAS8-37136 ..... N89-14249
NAS8-37358 ..... N89-14250
NAS9-17023 ..... N89-14998
NAS9-17720 ..... N89-14691
NA86AA-D-SG089 ..... N89-14778
NCC1-121 ..... N89-14401
NCC2-297 ..... N89-14824
NCC2-364 ..... N89-14825
NCC2-387 ..... N89-14695
NCC9-14 ..... N89-14998
NGL-05-020-243 ..... N89-14215
NGT-05-020-412 ..... N89-14456
NGT-19-010-900 ..... N89-14947

N89-14961
N89-14962
N89-14963
N89-14964
N89-14965
N89-14966
N89-14967
N89-14968
N89-14969
N89-14970
N89-14971
N89-14972
N89-14973
N89-14974
N89-14975
N89-14976
N89-14977
N89-14978
N89-14979
N89-14980
N89-14981
N89-14982
N89-14983
N89-14984
N89-14985
N89-14986
N89-14987
N89-14988
N89-14989
N89-14990
N89-14991
N89-14992

N89-14704
N89-14426
N89-14820
N89-14821
N89-14402
N89-14694
N89-14798
N89-14799
N89-14376
N89-14472
N89-14473
N89-14474
N89-14402
N89-14694
N89-14798
N89-14799
N89-14221
N89-14222
N89-14256
N89-14369
N89-14228
N89-14648
N89-14406
N89-14933
N89-14265
N89-14449
N89-14306
N89-14251
N89-14248
N89-14354
N89-14249
N89-14250
N89-14998
N89-14691
N89-14778
N89-14401
N89-14824
N89-14825
N89-14695
N89-14998
N89-14215
N89-14456
N89-14947
N89-14948
N89-14949
N89-14950
N89-14951
N89-14952
N89-14953
N89-14954
N89-14955
N89-14956
N89-14957
N89-14958
N89-14959
N89-14960
N89-14961
N89-14962
N89-14963

NGT-47-020-800 ..... N89-14896
NSF ATM-87-09659 ..... N89-14622
N89-14639
N89-14640

NSF CCR-87-06652 ..... N89-14714
NSF CEE-84-10547 ..... N89-14615
NSF DMS-86-01490 ..... N89-14792
NSF DMS-86-01858 ..... N89-14810
NSF ECE-85-15249 ..... N89-14776
NSF ECE-86-07591 ..... N89-14776
NSF ECS-85-06916 ..... N89-14713
NSF IRI-86-16644 ..... N89-14715
NSF MSM-86-13314 ..... N89-14458
NSG-1613 ..... N89-14725
NSG-3188 ..... N89-14450
N00014-78-C-0517 ..... N89-14282
N00014-80-C-0505 ..... N89-14741
N00014-82-F-0123 ..... N89-14383
N00014-82-K-0185 ..... N89-14307
N00014-82-K-0551 ..... N89-14447
N00014-83-C-0141 ..... N89-14327
N00014-84-C-0149 ..... N89-14359
N89-14734
N89-14885

N00014-84-C-2130 ..... N89-14358
N00014-84-K-0548 ..... N89-14827
N00014-85-C-0056 ..... N89-14312
N89-14313

N00014-85-C-0133 ..... N89-14690
N00014-85-C-2393 ..... N89-14642
N00014-85-K-0008 ..... N89-14762
N00014-85-K-0111 ..... N89-15062
N00014-85-K-0124 ..... N89-14689
N89-14715

N00014-85-K-0125 ..... N89-14714
N00014-85-K-0145 ..... N89-14307
N00014-85-K-0161 ..... N89-14321
N00014-85-K-0169 ..... N89-14792
N00014-85-K-0200 ..... N89-14479
N00014-85-K-0570 ..... N89-14718
N00014-85-K-0604 ..... N89-14396
N00014-86-C-0164 ..... N89-14330
N00014-86-F-0096 ..... N89-14257
N00014-86-F-0109 ..... N89-14869
N00014-86-K-0043 ..... N89-14894
N00014-86-K-0054 ..... N89-14944
N00014-86-K-0254 ..... N89-14826
N00014-86-K-0267 ..... N89-14283
N00014-86-K-0316 ..... N89-14287
N89-14288
N89-14382

N00014-86-K-0366 ..... N89-14863
N89-14272

N00014-86-K-0381 ..... N89-14273
N00014-86-K-0659 ..... N89-14464
N00014-86-K-0685 ..... N89-14322
N00014-86-K-0742 ..... N89-14689
N00014-87-C-0713 ..... N89-14713
N00014-87-C-0789 ..... N89-14309
N00014-87-C-2547 ..... N89-14888
N00014-87-J-1118 ..... N89-14252
N00014-87-K-0014 ..... N89-14278
N89-14302
N89-14887

N00014-88-K-0323 ..... N89-14886
N00039-84-C-0070 ..... N89-14360
N00140-82-G-BZ99 ..... N89-14696

N89-14964
N89-14965
N89-14966
N89-14967
N89-14968
N89-14969
N89-14970
N89-14971
N89-14972
N89-14973
N89-14974
N89-14975
N89-14976
N89-14977
N89-14978
N89-14979
N89-14980
N89-14981
N89-14982
N89-14983
N89-14984
N89-14985
N89-14986
N89-14987
N89-14988
N89-14989
N89-14990
N89-14991
N89-14992

N89-14622
N89-14639
N89-14640
N89-14714
N89-14615
N89-14792
N89-14810
N89-14776
N89-14776
N89-14713
N89-14715
N89-14458
N89-14725
N89-14450
N89-14282
N89-14741
N89-14383
N89-14307
N89-14447
N89-14327
N89-14359
N89-14734
N89-14885
N89-14358
N89-14827
N89-14312
N89-14313
N89-14690
N89-14642
N89-14762
N89-15062
N89-14689
N89-14715
N89-14714
N89-14307
N89-14321
N89-14792
N89-14479
N89-14718
N89-14396
N89-14330
N89-14257
N89-14869
N89-14894
N89-14944
N89-14826
N89-14283
N89-14287
N89-14288
N89-14382
N89-14863
N89-14272
N89-14273
N89-14464
N89-14322
N89-14689
N89-14713
N89-14309
N89-14888
N89-14252
N89-14278
N89-14302
N89-14887
N89-14886
N89-14360
N89-14696

N66269-80-C-0261 ..... N89-14243
N66001-83-D-0005 ..... N89-14740
N66001-84-D-0009 ..... N89-14628
N66001-85-C-0254 ..... N89-14719
N66001-85-D-0203 ..... N89-14836
N66001-87-C-0128 ..... N89-14707
RR04206 ..... N89-14690
SAA-C99066G ..... N89-14403
STPA-84-96501-00 ..... N89-14334
STPA-85-96-032-00-471-75-86 ..... N89-14335
STPA-86-96-015 ..... N89-14336
W-31-109-ENG-38 ..... N89-14432
N89-14700
N89-14872
N89-14873

W-7405-ENG-36 ..... N89-14274
N89-14315
N89-14355
N89-14356
N89-14394
N89-14430
N89-14445
N89-14697
N89-14698
N89-14699
N89-14703
N89-14780
N89-14802
N89-14830
N89-14831
N89-14832
N89-14855
N89-14860
N89-14861
N89-14892
N89-15061

W-7405-ENG-48 ..... N89-14246
N89-14316
N89-14317
N89-14370
N89-14410
N89-14411
N89-14435
N89-14436
N89-14461
N89-14462
N89-14786
N89-14833
N89-14877
N89-14943
N89-15011
N89-15012
N89-15067
N89-15068

073-36-00-00-72 ..... N89-14676
N89-14677
N89-14691

195-42-60 ..... N89-14842
199-04-36-01 ..... N89-15070
474-74-10 ..... N89-14247
480-30-07-01-72 ..... N89-14998
505-43-02 ..... N89-14386
505-51-61 ..... N89-14216
505-61-01-02 ..... N89-14241
505-61-71-02 ..... N89-14217
505-62-21 ..... N89-14221
N89-14222
N89-14403
N89-14794

505-63-1A ..... N89-14338
505-63-01-10 ..... N89-14472
N89-14473
N89-14474

505-63-11 ..... N89-14465
505-63-21 ..... N89-14215
505-63-51 ..... N89-14450
N89-14452
N89-14453

505-63-51-07 ..... N89-14821
505-68-11 ..... N89-14235
505-68-71-04 ..... N89-14213
505-68-91-12 ..... N89-14401
505-69-41 ..... N89-14237
505-90-01 ..... N89-14238
505-90-21-01 ..... N89-14402
N89-14694
N89-14798
N89-14799

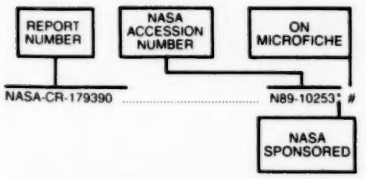
506-41-41 ..... N89-14310
506-42-21 ..... N89-14255
506-44-21-01 ..... N89-14426
506-63-91-01 ..... N89-14264
510-01-01 ..... N89-14297
533-02-5 ..... N89-14456
535-03-01 ..... N89-14220
535-03-11 ..... N89-14820

535-07-01 ..... N89-14470
582-01-11 ..... N89-14418
585-01-31-06 ..... N89-14475
586-01-11 ..... N89-14416
665-45-30-01 ..... N89-14634
674-25-05 ..... N89-14341
674-28-05 ..... N89-15047
763-01-61-02 ..... N89-14704
992-15-00-00-72 ..... N89-14331
N89-14332

# REPORT/ACCESSION NUMBER INDEX



### Typical Report Number Index Listing




Listings in this index are arranged alphanumerically by report number. The NASA accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.


A-87132 ..... N89-14216* #
A-88124 ..... N89-14995* #

AAMRL-TR-88-002 ..... N89-14680 #
AAMRL-TR-88-007-VOL-3 ..... N89-14688 #
AAMRL-TR-88-009 ..... N89-14685 #

ACT-95 ..... N89-14718 #

AD-A192453 ..... N89-14740 #
AD-A194708 ..... N89-14342* #
AD-A195809 ..... N89-14480 #
AD-A197308 ..... N89-14841 #
AD-A197359 ..... N89-14309 #
AD-A197472 ..... N89-14668 #
AD-A197855 ..... N89-14710 #
AD-A197858 ..... N89-14711 #
AD-A197864 ..... N89-14617 #
AD-A197879 ..... N89-14734 #
AD-A197880 ..... N89-14772 #
AD-A197883 ..... N89-14944 #
AD-A197913 ..... N89-14936 #
AD-A197915 ..... N89-14773 #
AD-A197928 ..... N89-14261 #
AD-A197930 ..... N89-14278 #
AD-A197936 ..... N89-14818 #
AD-A197937 ..... N89-14791 #
AD-A197939 ..... N89-14396 #
AD-A197940 ..... N89-14688 #
AD-A197942 ..... N89-14397 #
AD-A197943 ..... N89-14702 #
AD-A197945 ..... N89-14642 #
AD-A197949 ..... N89-14279 #
AD-A197955 ..... N89-14253 #
AD-A197956 ..... N89-14643 #
AD-A197957 ..... N89-14774 #
AD-A197962 ..... N89-14398 #
AD-A197965 ..... N89-14438 #
AD-A197969 ..... N89-14644 #
AD-A197971 ..... N89-14775 #
AD-A197972 ..... N89-14219 #
AD-A197979 ..... N89-14234 #
AD-A197980 ..... N89-14358 #
AD-A197994 ..... N89-14318 #
AD-A198003 ..... N89-14463 #
AD-A198005 ..... N89-14280 #
AD-A198014 ..... N89-14792 #
AD-A198018 ..... N89-14804 #
AD-A198025 ..... N89-14281 #
AD-A198030 ..... N89-14834 #
AD-A198039 ..... N89-14380 #
AD-A198040 ..... N89-14672 #
AD-A198042 ..... N89-14805 #
AD-A198052 ..... N89-14319 #
AD-A198055 ..... N89-14320 #
AD-A198060 ..... N89-14282 #
AD-A198061 ..... N89-14835 #
AD-A198067 ..... N89-14712 #
AD-A198068 ..... N89-14262 #
AD-A198084 ..... N89-14242 #
AD-A198086 ..... N89-14321 #
AD-A198088 ..... N89-14339 #
AD-A198090 ..... N89-14713 #
AD-A198096 ..... N89-14714 #
AD-A198098 ..... N89-14359 #
AD-A198099 ..... N89-14322 #
AD-A198101 ..... N89-14880 #
AD-A198131 ..... N89-14689 #
AD-A198132 ..... N89-14298 #
AD-A198133 ..... N89-14836 #
AD-A198139 ..... N89-14881 #
AD-A198146 ..... N89-14715 #
AD-A198194 ..... N89-14735 #
AD-A198290 ..... N89-14716 #
AD-A198291 ..... N89-14717 #
AD-A198292 ..... N89-14283 #
AD-A198300 ..... N89-14299 #
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AD-A198688 ..... N89-14669 #
AD-A198726 ..... N89-14685 #
AD-A198762 ..... N89-14625 #
AD-A198799 ..... N89-14272 #
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AD-A198979 ..... N89-14707 #
AD-A199003 ..... N89-14616 #

AD-1987-1121 ..... N89-14728 #
AD-1987-1271 ..... N89-14729 #

AFESC/ESL-TR-87-63 ..... N89-14617 #
AFESC/ESL-TR-88-53 ..... N89-14616 #

AFGL-ERP-1001 ..... N89-14414 #

AFGL-TR-88-0105 ..... N89-14414 #

AFHRL-TP-88-8 ..... N89-14775 #

AFIT/CI/NR-88-72 ..... N89-14219 #
AFIT/CI/NR-88-185 ..... N89-14644 #

AFOSR-88-0578TR ..... N89-14300 #
AFOSR-88-0707TR ..... N89-14262 #
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AFOSR-88-0789TR ..... N89-14720 #
AFOSR-88-0795TR ..... N89-14716 #
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AFOSR-88-0839TR ..... N89-14807 #
AFOSR-88-0841TR ..... N89-14805 #
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AFOSR-88-0905TR ..... N89-14627 #
AFOSR-88-0915TR ..... N89-14323 #

AFW-8767 ..... N89-14466 #

AFWAL-TR-87-1101 ..... N89-14740 #

AFWAL-TR-87-1185 N89-14696 #
AFWAL-TR-88-2007 N89-14400 #
AFWAL-TR-88-2011 N89-14502 #
AFWAL-TR-88-2022 N89-14227 #
AFWAL-TR-88-2034-VOL-2 N89-14281 #
AFWAL-TR-88-3030 N89-14466 #
AFWAL-TR-88-3031 N89-14463 #
AFWAL-TR-88-3032 N89-14466 #
AFWAL-TR-88-3063 N89-14735 #

AI-M-1017 N89-14715 #

AI-TR-1054 N89-14689 #

AIAA-89-0236 N89-15047* #
AIAA-89-0437 N89-14220* #
AIAA-89-0966 N89-14403* #

ANL/MCS-TM-125 N89-14700 #

ARCCB-TR-88029 N89-14340 #

ARI-RN-88-45 N89-14808 #
ARI-RN-88-46 N89-14936 #

ARO-20676.5-MS N89-14834 #
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ARO-22332.1-MA N89-14448 #
ARO-22561.10-CH N89-14285 #
ARO-22614.13-CH N89-14329 #
ARO-23475.4-MS N89-14881 #
ARO-24540.1-EL N89-14880 #
ARO-25224.1-EL N89-14882 #

ASD-TR-88-5022 N89-14226 #

AVSCOM-TR-87-C-36 N89-14453* #
AVSCOM-TR-88-C-021 N89-14450* #
AVSCOM-TR-88-C-032 N89-14452* #

B-11 N89-14214 #

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B8823228 N89-14993 #

CASS/ESM-88-7 N89-14307 #

CBPF-NF-021/87 N89-14812 #

CERL-TR-P-88/19 N89-14721 #

CONF-870416-7 N89-14496 #
CONF-880207-7 N89-14872 #
CONF-880514-5 N89-14671 #
CONF-880521-5 N89-14667 #
CONF-880702-23 N89-14831* #
CONF-880705-9 N89-14394 #
CONF-880715-9 N89-14873 #
CONF-880789-2 N89-14315 #
CONF-880812-7 N89-14874 #
CONF-880841-21 N89-14875 #
CONF-880887-14 N89-15068 #
CONF-880888-10 N89-14436 #
CONF-880912-14 N89-14316 #
CONF-880932-2 N89-14498 #
CONF-880950-2 N89-14314 #
CONF-880965-4 N89-14499 #
CONF-880965-8 N89-14501 #
CONF-880965-9 N89-14500 #
CONF-880967-1 N89-14859 #
CONF-881002-2 N89-14429 #
CONF-881015-4 N89-14854 #
CONF-881015-5 N89-14855 #
CONF-881015-8 N89-14862 #
CONF-881015-14 N89-14858 #
CONF-881030-2 N89-14943 #
CONF-881031-9 N89-14861 #
CONF-881031-11 N89-14860 #
CONF-881049-11 N89-14830 #
CONF-881049-12 N89-14356 #
CONF-881054-6 N89-14277 #
CONF-881058-2 N89-14686 #
CONF-881058-3 N89-14935 #
CONF-881076-3 N89-14941 #
CONF-881076-5 N89-14942 #
CONF-881076-7 N89-14459 #
CONF-881076-8 N89-14460 #
CONF-881084-1 N89-14876 #
CONF-881093-2 N89-14246 #
CONF-881112-1 N89-14703 #
CONF-881112-6 N89-14697 #
CONF-881116-2 N89-14446 #
CONF-881116-3 N89-14687 #
CONF-881151-4 N89-14892 #
CONF-881151-6 N89-14355 #
CONF-881174-2 N89-14412 #
CONF-8810203-2 N89-14709 #
CONF-8708276-1 N89-14732 #
CONF-8712108-1 N89-14409 #
CONF-8804125-2 N89-14733 #
CONF-8804181-1 N89-14260 #
CONF-8804182-1 N89-14292 #
CONF-8804192-1 N89-15067 #
CONF-8806125-4 N89-14786 #
CONF-8806204-4 N89-15061 #
CONF-8806234-2 N89-14802 #
CONF-8806236-2 N89-14432 #
CONF-8807105-1 N89-14430 #
CONF-8807106-1 N89-14430 #
CONF-8808103-3 N89-14410 #
CONF-8808103-4 N89-14411 #
CONF-8808106-4 N89-14879 #
CONF-8808120-1 N89-14445 #
CONF-8808124-1 N89-14462 #
CONF-8808124-2 N89-14461 #
CONF-8809105-2 N89-14275 #
CONF-8809105-3 N89-14832 #
CONF-8809105-4 N89-14833 #
CONF-8809109-4 N89-14395 #
CONF-8809123-1 N89-14877 #
CONF-8809131-1 N89-14317 #
CONF-8809149-1 N89-14437 #
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CONF-8810162-1 N89-14698 #

CSSA-ASTRO-88-12 N89-15062 #

CU-CS-153-7622 N89-14944 #

DAC-12 N89-14734 #

DBMS.NASA/PC-R/D-1 N89-14973* #
DBMS.NASA/PC-R/D-2 N89-14974* #
DBMS.NASA/PC-R/D-3 N89-14975* #
DBMS.NASA/PC-R/D-4 N89-14976* #
DBMS.NASA/PC-R/D-5 N89-14977* #
DBMS.NASA/PC-R/D-6 N89-14978* #
DBMS.NASA/PC-R/D-7 N89-14979* #
DBMS.NASA/PC-R/D-8 N89-14980* #
DBMS.NASA/PC-R/D-9 N89-14981* #
DBMS.NASA/PC-R/D-10 N89-14982* #
DBMS.NASA/PC-R/D-11 N89-14983* #
DBMS.NASA/PC-R/D-12 N89-14984* #
DBMS.NASA/PC-R/D-13 N89-14985* #
DBMS.NASA/PC-R/D-14 N89-14986* #
DBMS.NASA/PC-R/D-15 N89-14987* #
DBMS.NASA/PC-R/D-16 N89-14988* #
DBMS.NASA/PC-R/D-17 N89-14989* #
DBMS.NASA/PC-R/D-18 N89-14990* #
DBMS.NASA/PC-R/D-19 N89-14991* #
DBMS.NASA/PC-R/D-20 N89-14992* #

DBMS.NASA/RECON-1 N89-14949* #
DBMS.NASA/RECON-2 N89-14950* #
DBMS.NASA/RECON-3 N89-14951* #
DBMS.NASA/RECON-4 N89-14952* #
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DBMS.NASA/RECON-6 N89-14954* #
DBMS.NASA/RECON-7-PT-1 N89-14955* #
DBMS.NASA/RECON-8-PT-2 N89-14956* #
DBMS.NASA/RECON-9 N89-14957* #
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DBMS.NASA/RECON-22 N89-14970* #
DBMS.NASA/RECON-23 N89-14971* #
DBMS.NASA/RECON-24 N89-14972* #

DE88-001178 N89-14497 #
DE88-004793 N89-14368 #
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DE88-016149 N89-14780 #
DE88-016172 N89-14943 #
DE88-016239 N89-14430 #
DE88-016269 N89-14410 #
DE88-016275 N89-15067 #
DE88-016324 N89-14445 #
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DE88-016742 N89-14709 #
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DE88-017005 N89-15068 #
DE88-017006 N89-14316 #
DE88-017009 N89-14411 #
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DE88-017022 N89-14461 #
DE88-017026 N89-14786 #
DE88-017027 N89-14462 #
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DE88-017140 N89-14274 #
DE88-017151 N89-14496 #
DE88-017167 N89-14498 #
DE88-017168 N89-14395 #
DE88-017175 N89-14275 #
DE88-017200 N89-14699 #
DE88-017241 N89-14891 #
DE88-017256 N89-14393 #
DE88-017264 N89-14700 #
DE88-017281 N89-14431 #
DE88-017305 N89-14276 #
DE88-017306 N89-14856 #
DE88-017307 N89-14857 #
DE88-017316 N89-14781 #
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DE89-000327 N89-14830 #

DE89-000340 ..... N89-14356 #
DE89-000341 ..... N89-14831* #
DE89-000368 ..... N89-14315 #
DE89-000371 ..... N89-14394 #
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DE89-000409 ..... N89-14349 #
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DE89-000558 ..... N89-14874 #
DE89-000567 ..... N89-14433 #
DE89-000568 ..... N89-14875 #
DE89-001016 ..... N89-14434 #
DE89-001036 ..... N89-14357 #
DE89-001061 ..... N89-14296 #
DE89-001062 ..... N89-14379 #
DE89-001341 ..... N89-14785 #

DFVLR-FB-28-28 ..... N89-14731 #
DFVLR-FB-88-29 ..... N89-14633 #

DODA-AR-005-348 ..... N89-14236 #

DOE/CS-50101/H1-VOL-2 ..... N89-14378 #

DOE/DP-40200/77 ..... N89-14434 #

DOE/ER-0386 ..... N89-14784 #
DOE/ER-03130/39C ..... N89-14732 #
DOE/ER-13728/1 ..... N89-14393 #
DOE/ER-13766/2 ..... N89-14431 #
DOE/ER-25026/T2 ..... N89-14783 #
DOE/ER-25026/24 ..... N89-14781 #
DOE/ER-40136/T8 ..... N89-14433 #
DOE/ER-40231/T4 ..... N89-14891 #
DOE/ER-45172/T2 ..... N89-14293 #
DOE/ER-45285/2 ..... N89-14294 #
DOE/ER-60501/1 ..... N89-14276 #

DOE/ET-29372/8 ..... N89-14421* #
DOE/ET-52047/6 ..... N89-14857 #
DOE/ET-52047/7 ..... N89-14856 #

DOE/S-0067 ..... N89-14996 #

DRC-R-486-U ..... N89-14696 #

DRET-86-1507/DS/SR ..... N89-14797 #

DTRC-88/017 ..... N89-14841 #

DTRC/SME-88-30 ..... N89-14298 #

D180-30962-1 ..... N89-14227 #

E-1737 ..... N89-14386* #
E-4083 ..... N89-14221* #
E-4084 ..... N89-14222* #
E-4169 ..... N89-14794* #
E-4226 ..... N89-14450* #
E-4254 ..... N89-14842* #
E-4379 ..... N89-14255* #
E-4381 ..... N89-14235* #
E-4413 ..... N89-14452* #
E-4419 ..... N89-14341* #
E-4430 ..... N89-14238* #
E-4451 ..... N89-14465* #
E-4466 ..... N89-14416* #
E-4477 ..... N89-15047* #
E-4485 ..... N89-14310* #
E-4486 ..... N89-14297* #
E-4497 ..... N89-14403* #
E-4509 ..... N89-14220* #
E-4519 ..... N89-14237* #
E-4520 ..... N89-14470* #
E-4530 ..... N89-14418* #
E-4539 ..... N89-14239* #
E-4542 ..... N89-14453* #
E-4553 ..... N89-14247* #
E-4561 ..... N89-14338* #

EGG-M-88284 ..... N89-14935 #

EM-7140-17 ..... N89-14482 #

EP-192 ..... N89-14895* #
EP-222 ..... N89-14684* #

EPA-400/1-87-001A-VOL-1 ..... N89-14610 #
EPA-400/1-87-001F-VOL-6 ..... N89-14611 #
EPA-400/1-87-001G-VOL-7 ..... N89-14612 #
EPA-400/1-87-001H-VOL-8 ..... N89-14613 #
EPA-600/D-88-118 ..... N89-14608 #
EPA-600/D-88-142 ..... N89-14614 #
EPA-600/4-88-026 ..... N89-14270 #
EPA-600/8-88-073B ..... N89-14609 #

EPA/SW/MT-88/053B ..... N89-14609 #

ESA-BR-52 ..... N89-14244 #

ESA-CR(P)-2637 ..... N89-14254 #

ESD-TR-87-251 ..... N89-14342* #

ESL-719493-2 ..... N89-14725* #

ETN-89-93167 ..... N89-14254 #
ETN-89-93327 ..... N89-14485 #
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ETN-89-93335 ..... N89-14229 #
ETN-89-93336 ..... N89-14492 #
ETN-89-93337 ..... N89-14493 #
ETN-89-93338 ..... N89-14494 #
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ETN-89-93352 ..... N89-14796 #
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ETN-89-93417 ..... N89-14365 #
ETN-89-93418 ..... N89-14372
ETN-89-93419 ..... N89-14454 #
ETN-89-93442 ..... N89-14728 #
ETN-89-93443 ..... N89-14729 #
ETN-89-93446 ..... N89-14730 #
ETN-89-93448 ..... N89-14373 #
ETN-89-93449 ..... N89-14692 #
ETN-89-93450 ..... N89-14230 #
ETN-89-93454 ..... N89-14945
ETN-89-93456 ..... N89-14223
ETN-89-93570 ..... N89-14828
ETN-89-93571 ..... N89-14819
ETN-89-93572 ..... N89-14629
ETN-89-93573 ..... N89-14301
ETN-89-93574 ..... N89-14724
ETN-89-93576 ..... N89-14646
ETN-89-93579 ..... N89-14657
ETN-89-93580 ..... N89-14647
ETN-89-93581 ..... N89-14631
ETN-89-93582 ..... N89-14649
ETN-89-93583 ..... N89-14650
ETN-89-93584 ..... N89-14632
ETN-89-93585 ..... N89-14244 #
ETN-89-93586 ..... N89-14937 #
ETN-89-93598 ..... N89-14333 #
ETN-89-93599 ..... N89-14451 #
ETN-89-93600 ..... N89-14674 #
ETN-89-93601 ..... N89-14471 #
ETN-89-93602 ..... N89-14797 #
ETN-89-93603 ..... N89-14334 #
ETN-89-93604 ..... N89-14335 #
ETN-89-93605 ..... N89-14336 #
ETN-89-93658 ..... N89-14633 #
ETN-89-93755 ..... N89-14731 #

FAA-EE-88-4 ..... N89-14616 #

FEL-1987-76 ..... N89-14630 #
FEL-1988-01 ..... N89-14495 #
FEL-1988-04 ..... N89-14365 #
FEL-1988-15 ..... N89-14372

FNAL/C-88/97 ..... N89-14733 #

FOA-C-30485-4.2 ..... N89-14353 #

FTD-ID(RS)T-0386-88 ..... N89-14366 #

GA-A-19393 ..... N89-14858 #

GRI-87/0279 ..... N89-14444 #
GRI-88/0192 ..... N89-14308 #

H-1514 ..... N89-14456* #
H-1529 ..... N89-14683* #

HAC-REF-F7182 ..... N89-14834 #

HDL-TR-2148 ..... N89-14883 #

IAEA-CN-50/B-2-5 ..... N89-14862 #
IAEA-CN-50/C-2-3 ..... N89-14858 #
IAEA-CN-50/C-4-4-1 ..... N89-14855 #
IAEA-CN-50/G-3-2 ..... N89-14854 #

ICASE-88-68 ..... N89-14402* #
ICASE-88-69 ..... N89-14799* #
ICASE-88-71 ..... N89-14798* #

ICOMP-88-11 ..... N89-14794* #
ICOMP-88-21 ..... N89-14403* #

IITRI-EO6595-1 ..... N89-14360 #

INDU/DC/GMH/TR-88-28 ..... N89-14273 #
INDU/DC/GMH/TR-88-33 ..... N89-14272 #

IR-143 ..... N89-14938 #

ISBN-0-86839-8829 ..... N89-14638 #
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ISSN-0143-7143 ..... N89-14819
ISSN-0143-7313 ..... N89-14301
ISSN-0143-7313 ..... N89-14724
ISSN-0169-1651 ..... N89-14646
ISSN-0169-1708 ..... N89-14631
ISSN-0169-1708 ..... N89-14632
ISSN-0169-1708 ..... N89-14647
ISSN-0169-1708 ..... N89-14649
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ISSN-0169-1708 ..... N89-14657
ISSN-0171-1342 ..... N89-14633 #
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ISSN-0920-2358 ..... N89-14993 #

IWECO-5176814-87-1 ..... N89-14730 #

IZF-1987-23 ..... N89-14373 #
IZF-1987-24 ..... N89-14692 #
IZF-1987-32 ..... N89-14230 #
IZF-1988-03 ..... N89-14945

JAERI-M-88-087 ..... N89-14782 #

JINR-E-5-87-698 ..... N89-14803 #

JINR-R-2-87-504 ..... N89-15069 #
JINR-R-2-87-819 ..... N89-14893 #
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JINR-R-8-87-604 ..... N89-14413 #
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JINR-R-11-87-722 ..... N89-14789 #
JINR-R-13-87-774 ..... N89-14701 #
JINR-R-14-86-857 ..... N89-14866 #
JINR-R-17-87-405 ..... N89-14790 #

JPL-PUBL-88-1 ..... N89-14421* #

JPRS-ULS-87-008 ..... N89-14658 #

KFTI-87-24 ..... N89-14295 #

KNMI-TR-104 ..... N89-14657
KNMI-TR-105 ..... N89-14647
KNMI-TR-106 ..... N89-14631
KNMI-TR-107 ..... N89-14649
KNMI-TR-108 ..... N89-14650
KNMI-TR-109 ..... N89-14632

KNMI-WR-87-11 ..... N89-14646

L-16426 N89-14213* #
L-16449 N89-14634* #
L-16481 N89-14217* #
L-16515 N89-14241*

LA-UR-88-890 N89-14703 #
LA-UR-88-1970 N89-14697 #
LA-UR-88-2569 N89-14430 #
LA-UR-88-2678 N89-14698 #
LA-UR-88-2688 N89-14445 #
LA-UR-88-2782 N89-14832 #
LA-UR-88-2823 N89-14780 #
LA-UR-88-2840 N89-14855 #
LA-UR-88-2888 N89-14861 #
LA-UR-88-2890 N89-14860 #
LA-UR-88-2920 N89-14802 #
LA-UR-88-2927 N89-15061 #
LA-UR-88-2988 N89-14394 #
LA-UR-88-3019 N89-14315 #
LA-UR-88-3193 N89-14892 #
LA-UR-88-3206 N89-14355 #
LA-UR-88-3251 N89-14356 #
LA-UR-88-3253 N89-14831* #
LA-UR-88-3278 N89-14830 #

LA-11424-MS N89-14699 #

LALP-88-18 N89-14274 #

LBL-25576 N89-14409 #
LBL-25779 N89-14875 #
LBL-25842 N89-14874 #

LC-87-619857 N89-14811 #

LMI-IR701R1 N89-14234 #

LMSC-D878511 N89-14472* #
LMSC-D8785111 N89-14473* #

LMSC-HREC-TR-D867354 N89-14704* #

LPI-TRN-88-09 N89-15059* #

MIT/LCS/TR-419 N89-14714 #

MITSG-87-19 N89-14778 #

MM-AL/AP-04-88 N89-14471 #

MSU-EE-FIN-10A-88 N89-14354* #
MSU-EE-FIN-10B-88 N89-14248* #

MTL-TR-88-23 N89-14299 #

NA-88-0011 N89-14243 #

NADC-79024-60-1 N89-14243 #

NARA/TIP-88/04 N89-14939 #

NAS 1.15:4065 N89-14476* #
NAS 1.15:4080 N89-14217* #
NAS 1.15:4090 N89-14241*
NAS 1.15:83439 N89-14386* #
NAS 1.15:89435 N89-14216* #
NAS 1.15:100088 N89-14995* #
NAS 1.15:100459-VOL-1 N89-14331* #
NAS 1.15:100459-VOL-2 N89-14332* #
NAS 1.15:100466 N89-14676* #
NAS 1.15:100467 N89-14691* #
NAS 1.15:100468 N89-14677* #
NAS 1.15:100469 N89-14693* #
NAS 1.15:100916 N89-14794* #
NAS 1.15:101194 N89-14651* #
NAS 1.15:101200 N89-14831* #
NAS 1.15:101207 N89-15059* #
NAS 1.15:101217 N89-14934* #
NAS 1.15:101247 N89-14825* #
NAS 1.15:101352 N89-14255* #
NAS 1.15:101372 N89-14341* #
NAS 1.15:101376 N89-14238* #
NAS 1.15:101389 N89-14465* #
NAS 1.15:101393 N89-14416* #
NAS 1.15:101397 N89-15047* #
NAS 1.15:101401 N89-14310* #
NAS 1.15:101402 N89-14297* #
NAS 1.15:101405 N89-14403* #
NAS 1.15:101410 N89-14450* #
NAS 1.15:101417 N89-14220* #
NAS 1.15:101420 N89-14237* #
NAS 1.15:101421 N89-14470* #
NAS 1.15:101428 N89-14418* #
NAS 1.15:101433 N89-14239* #
NAS 1.15:101435 N89-14452* #
NAS 1.15:101438 N89-14453* #
NAS 1.15:101447 N89-14247* #
NAS 1.15:101451 N89-14338* #
NAS 1.15:101500 N89-14475* #
NAS 1.15:101501 N89-14264* #
NAS 1.15:101516 N89-15070* #
NAS 1.15:101522 N89-14994* #
NAS 1.15:101694 N89-14683* #
NAS 1.21:7011(318) N89-14675*
NAS 1.26:4147-PT-1 N89-14221* #
NAS 1.26:4147-PT-2 N89-14222* #
NAS 1.26:4183 N89-14704* #
NAS 1.26:4186 N89-14215* #
NAS 1.26:4189 N89-14426* #
NAS 1.26:4194 N89-14235* #
NAS 1.26:4208 N89-14820* #
NAS 1.26:4210 N89-14401* #
NAS 1.26:4212 N89-14821* #
NAS 1.26:178384 N89-14472* #
NAS 1.26:179395 N89-14933* #
NAS 1.26:179401 N89-14249* #
NAS 1.26:179416 N89-14306* #
NAS 1.26:179422 N89-14251* #
NAS 1.26:179424 N89-14250* #
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NAS 1.26:183322 N89-14621* #
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NAS 1.26:184507 N89-14947* #
NAS 1.26:184508 N89-14948* #
NAS 1.26:184509 N89-14949* #
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NAS 1.26:184568 N89-14708* #
NAS 1.26:184577 N89-14417* #
NAS 1.26:184595 N89-14726* #
NAS 1.26:184596 N89-14725* #
NAS 1.26:184611 N89-14449* #
NAS 1.26:184614 N89-14795* #
NAS 1.26:184615 N89-14946* #
NAS 1.26:184618 N89-14469* #
NAS 1.26:184628 N89-14421* #
NAS 1.26:184652 N89-15063* #
NAS 1.26:184653 N89-14800* #
NAS 1.26:184655 N89-14810* #
NAS 1.55:2494 N89-14998* #
NAS 1.55:10014 N89-14503* #
NAS 1.55:10018 N89-14842* #
NAS 1.60:2856 N89-14213* #
NAS 1.61:1206 N89-14634* #
NAS 1.61:1210 N89-14648* #
NAS 1.71:LAR-13225-1 N89-14258* #
NAS 1.71:LAR-13771-1 N89-14428* #
NAS 1.71:LAR-13775-1 N89-14408* #
NAS 1.71:LAR-13875-1 N89-14233* #
NAS 1.71:LAR-14031-1 N89-14232* #
NAS 1.71:LEW-14295-1 N89-14348* #
NAS 1.71:LEW-14472-1 N89-14259* #
NAS 1.71:MSC-21293-1 N89-14666* #
NAS 1.77:20327 N89-14271* #
NAS 1.77:20365 N89-14245* #
NAS 1.77:20380 N89-14870* #
NAS 1.77:20435 N89-14737* #

NASA-CASE-ARC-11536-1 N89-14384*

NASA-CASE-GSC-12892-1 N89-14374*

NASA-CASE-LAR-13215-1 N89-14224*
NASA-CASE-LAR-13225-1 N89-14258* #
NASA-CASE-LAR-13300-1-CU N89-14407*
NASA-CASE-LAR-13552-1-CU N89-14385*
NASA-CASE-LAR-13601-1-CU N89-14337*
NASA-CASE-LAR-13771-1 N89-14428* #
NASA-CASE-LAR-13775-1 N89-14408* #
NASA-CASE-LAR-13853-1 N89-14423*
NASA-CASE-LAR-13875-1 N89-14233* #
NASA-CASE-LAR-14031-1 N89-14232* #

NASA-CASE-LEW-14134-2 N89-14303*
NASA-CASE-LEW-14295-1 N89-14348* #
NASA-CASE-LEW-14472-1 N89-14259* #

NASA-CASE-MFS-28217-1 N89-14392*

NASA-CASE-MSC-21293-1 N89-14666* #

NASA-CASE-NPO-17086-1-CU N89-14422*
NASA-CASE-NPO-17143-1-CU N89-14351*

NASA-CP-2494 N89-14998* #
NASA-CP-10014 N89-14503* #
NASA-CP-10018 N89-14842* #

NASA-CR-4147-PT-1 N89-14221* #
NASA-CR-4147-PT-2 N89-14222* #
NASA-CR-4183 N89-14704* #
NASA-CR-4186 N89-14215* #
NASA-CR-4189 N89-14426* #
NASA-CR-4194 N89-14235* #
NASA-CR-4208 N89-14820* #
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NASA-CR-178384 N89-14472* #
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NASA-CR-184528 ..... N89-14968* #
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NASA-CR-184548 ..... N89-14988* #
NASA-CR-184549 ..... N89-14989* #
NASA-CR-184550 ..... N89-14990* #
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NASA-CR-184615 ..... N89-14946* #
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NASA-TM-101428 ..... N89-14418* #
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NASA-TM-101438 ..... N89-14453* #
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PB88-240049 ..... N89-14308 #
PB88-241849 ..... N89-14869 #
PB88-243373 ..... N89-14390* #
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PB88-250568 ..... N89-14444 #

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PNL-6684 ..... N89-14641 #

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RADC-TR-88-17 ..... N89-14362 #
RADC-TR-88-76 ..... N89-14711 #

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REPT-48-453/F ..... N89-14335 #
REPT-49-064/F ..... N89-14336 #
REPT-87-MA-04 ..... N89-14678 #
REPT-87-MA-09 ..... N89-14801 #
REPT-88 ..... N89-14655 #
REPT-88-34 ..... N89-14993 #
REPT-88-181 ..... N89-14648* #
REPT-88B0234 ..... N89-14503* #
REPT-129 ..... N89-14739 #
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REPT-1987-4 ..... N89-14342* #

RIACS-TR-88.3 ..... N89-14695* #

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S-580 ..... N89-14676* #
S-582 ..... N89-14691* #
S-583 ..... N89-14677* #

S-584 ..... N89-14693* #

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SACLANTCEN-SM-207 ..... N89-14483 #

SACLANTCEN-SR-137 ..... N89-14484 #

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SAND-87-2582C ..... N89-14292 #
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SAND-88-0989C ..... N89-14879 #
SAND-88-1235C ..... N89-14277 #
SAND-88-1351 ..... N89-14296 #
SAND-88-1417C ..... N89-14941 #
SAND-88-1419 ..... N89-14357 #
SAND-88-1429C ..... N89-14942 #
SAND-88-1486C ..... N89-14459 #
SAND-88-1716 ..... N89-14997 #
SAND-88-1782C ..... N89-14460 #
SAND-88-2068C ..... N89-14709 #
SAND-88-2340C ..... N89-14412 #
SAND-88-2349 ..... N89-14498 #
SAND-88-2426 ..... N89-14395 #
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SAND-88-2507C ..... N89-14437 #
SAND-88-7027 ..... N89-14379 #

SBIR-88-1 ..... N89-14934* #

SERI/SP-210-3357 ..... N89-14497 #

SETEC-MME-84-019-VOL-1 ..... N89-14712 #

SOR-88-7 ..... N89-14809 #

SWRI-8578/5 ..... N89-14324 #

TACOM-TR-13121-VOL-1 ..... N89-14712 #

TAL-RP-SN-003 ..... N89-14254 #

TD-87-3579 ..... N89-14730 #
TD-87-4247 ..... N89-14373 #
TD-87-4831 ..... N89-14692 #
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TD-88-0925 ..... N89-14945
TD-88-1634 ..... N89-14365 #
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TPD-1987-0-2-PT-2 ..... N89-14454 #

TR-F101/85/0129-C ..... N89-14711 #

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TR-7 ..... N89-14309 #
TR-19 ..... N89-14312 #
TR-21 ..... N89-14313 #
TR-54 ..... N89-14863 #
TR-56 ..... N89-14287 #
TR-1180-1 ..... N89-14226* #

TTC-0828 ..... N89-14412 #

UAH-750 ..... N89-14417* #

UBUFFALO/DC/88/TR-81 ..... N89-14894 #

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UCRL-21108 ..... N89-14370 #
UCRL-97617 ..... N89-14943 #
UCRL-98175 ..... N89-15068 #
UCRL-98370 ..... N89-14677 #
UCRL-98479 ..... N89-14316 #
UCRL-98483 ..... N89-14410 #
UCRL-98498 ..... N89-14411 #
UCRL-98561 ..... N89-14461 #
UCRL-98562 ..... N89-14462 #
UCRL-98991 ..... N89-14786 #
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UCRL-99457 ..... N89-14833 #
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UDR-TR-88-02-VOL-2 ..... N89-14281 #

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US-PATENT-CLASS-324-77-R ..... N89-14385*
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US-PATENT-CLASS-324-78-F ..... N89-14385*
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US-PATENT-CLASS-356-28.5 ..... N89-14384*
US-PATENT-CLASS-356-28.5 ..... N89-14385*
US-PATENT-CLASS-364-484 ..... N89-14385*
US-PATENT-CLASS-364-900 ..... N89-14384*
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US-PATENT-CLASS-420-62 ..... N89-14303*
US-PATENT-CLASS-420-79 ..... N89-14303*
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US-PATENT-4,770,238 ..... N89-14392*
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US-PATENT-4,777,656 ..... N89-14374*
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US-PATENT-4,779,222 ..... N89-14384*
US-PATENT-4,779,428 ..... N89-14351*
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